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SYSTEMS OF HIEROGLYPHIC WRITING IN MIDDLE AMERICA AND METHODS OF DECIPHERING THEM

J. Eric S. Thompson

RECENT disagreement on the nature of Maya hieroglyphic writing calls for a reappraisal of the historical sources, and an examination of alternative methods of decipherment. Unfortunately, no one has both a thorough grasp of the subject and an unbiased attitude.

Landa's Alphabet

Diego de Landa, bishop of Yucatán and the author of that bible of Maya students, *Relación de las cosas de Yucatán* (Tozzer 1941), written nearly 400 years ago, has stirred up much discord. He fought a series of heavy and acrimonious engagements with his fellow countrymen, lay and clerical; he caused great unrest and bitter feeling among the Maya; and from the grave he has inspired much controversial writing since the rediscovery and publication, 98 years ago, of his *Relación* with its famous — some might say infamous — Maya alphabet. This so-called alphabet (Fig. 1 *d*) republished in Whorf (1933), in Tozzer (1941) and elsewhere, consists of 27 signs corresponding to the *Spanish names* of such letters of the alphabet as represent sounds present also in Maya, for it is abundantly clear (Thompson 1953) that Landa pronounced the letters *name by name*. On the subject of writing and Maya characters he has this to say:

> This people also made use of certain characters or letters with which they wrote in their books their antiquities and sciences, and with these figures and some signs in their figures they understood their things and taught them and made them understood. . . .
>
> Of their letters I will put down here an A.B.C.; their clumsiness does not permit more, for they use a character for all the aspirations [*aspiraciones*], and then they join it to part of another, and thus they come to be *ad infinitum*, as one can see in the following example. *Le* means "noose" and "to trap game with a snare"; to write *le* with their characters, *after we had made them understand that they are two letters* [italics of J. E. S. T.], they used to write it with three, putting for the aspiration of the *l* [called *ele* and pronounced *aylay* in Spanish] the vowel *e*, which it has before it, and in this they do not err, although they may use *e* if they wish, as a curiosity [*por curiosidad*]. Then, at the end they stick to it the joined part. Example: [Fig. 1 *a*].
>
> *Ha* means water. As *h* [called *hache* and pronounced *achay*] has an *a* in front of it, they put it down with *a* at the beginning and at the end thus: [Fig. 1 *b*].
>
> They also write by parts, but I would not put down either the one way or the other save only to give a complete account of the affairs of this people: *Ma in kati* means "I do not wish," and they write it by parts in this way [Fig. 1 *c*]. There follows their A.B.C. [Fig. 1 *d*].
>
> This language lacks the letters which are not given here, and it has others added from ours for other things of which it has need, and nowadays they do not use these characters for anything, especially the young people who have learned ours. (Translated from Spanish by J. E. S. T.)

Valentini (1880) quickly established that Landa's informant had drawn for the alphabet signs or glyphs with Maya names corresponding with reasonable closeness to the sounds of the Spanish letters. For *a* one glyph is the head of a turtle, *ac* in Yucatec; for *b* (Spanish *be*) it is a footprint, symbol throughout Middle America for road or journey (*be* in Maya). For *c* (pronounced *say*) the informant drew the month sign Zec (pronounced *sayc*). Unfortunately, a distressingly large number of Spanish letters end in *e*. One of two signs for *l* (*ele*) seems to be a leaf (*le*); for *n* (*ene*) it is probably the tail (*ne*) of a monkey. The head of the god Xipe seems to stand for *p'*, and a vomiting (*xe*) man seems to be the action corresponding to *x*. Some signs are obvious; others are indistinct or escape interpretation.

Several deductions can be made:

1. Correct symbols for road, turtle, the month Zec, the locative *ti*, and the *u* bracket make it certain that Landa's informant was acquainted with the glyphs.

2. Some of the signs the informant drew could not have been in general use for a syllabic or alphabetic writing. For instance, footprints are fairly common in pictures of travel and perhaps have other meanings, but only twice in the whole range of Maya writing does a foot-

FIG. 1. Glyphs. *a*, *le*, snare, according to Landa; *b*, *ha*, water, according to Landa; *c*, *ma in kati*, I do not wish, according to Landa; *d*, Landa's alphabet; *e*, *f*, affixes denoting water (*ha*) Chichén Itzá and Palenque (compare with sign for *ha* in *b*); *g*, glyph for Tenantzinco, Codex Mendoza; *h*, glyph for Mixtlan, Codex Mendoza; *i*, glyph for Viceroy Antonio Mendoza, Codex of 1576; *j*, *k*, augural glyphs for evil (*kas*) and very good tidings according to Thompson; *l*, *kas* and good tidings glyphs combined; *m*, glyph for dog; *n*, Beyer's gouged eye, sacrificial glyph, Chichén Itzá (note differences from Landa's *l*, in *d*); *o-r*, representations of leaves, Madrid 96 *a*, and Chichén Itzá; *s*, Knorozov's *mut*, Dresden 17 *b*; *t*, same reversed, with same picture, Madrid 94 *c*; *u*, *v*, sentences on Dresden 19 *b*.

print appear as a glyphic element, yet *be* is a component of many Maya words and *b* is a very common consonant. The head for *p*, perhaps, *pek*, dog, for the distinctive eye occurs in one picture of a dog (Dresden 21 *b*), appears as a glyph only twice in the codices (Zimmermann's Glyph 716). Therefore, it can hardly have been in everyday use to represent the sounds *pe* or *p*. The sound *x* (English *sh*, the Arabic *shin*) is very common in Maya, but glyphs of vomiting men are not. Turning to vowels, we may note that both elements given the sound value *o*, two of the three signs for *a*, and one of the two signs for *u* never appear as main signs, as one would expect if there was a system of writing such as Landa describes, for most Maya words are monosyllabic, and the combination consonant-vowel-consonant is commonest. Moreover, the supposed glyphic equivalents of vowels with the exception of the *u* signs are also quite rare.

3. From the above we have concluded that Landa's informant was acquainted with the hieroglyphs, but gave for some common consonants of the alphabet glyphic elements which very seldom appear in surviving Maya texts, and for vowels he supplied elements which are for the most part rare and, in addition, affixes rather than main elements such as one would expect were there an alphabetical system.

We can now make one of three deductions: *a*, the informant did not supply material for reading Maya inscriptions by an alphabetic or syllabic system because none existed; *b*, there was such a system but it was not used in the surviving Maya texts; *c*, the informant wished to deceive Landa. That Landa's system per se cannot be used to read the glyphs is too well known to need comment (I omit the question of modifications and expansions which various authors have suggested in recent years as not pertinent to the discussion). If the informant was giving data on a system which has not survived, the alphabet is purely academic. Deliberate deception is a possibility, but not a probability, for as we have seen, some glyphic elements certainly have the sound values assigned them. We must accept deduction *a*, the informant did not supply an alphabetic or syllabic system because none existed. Landa's informant was probably Juan (Nachi) Cocom, who, he tells us, was very intimate with him and gave him much information on the old ways. This Cocom, a former *halach uinic* (head chief), certainly knew as much about the Maya hieroglyphs as anyone, and presumably would not have hesitated to give information which would have glorified the Maya past.

Those two words Landa gives, *le* and *ha*, tell us a great deal. It is not difficult to picture the thatch and white-washed walls of *cal y canto* with lizards basking in the sun of the early afternoon, and, as part of the scene, Landa, hot tempered and impatient as we know him to have been, and Cocom mentally digging in his heels. Landa is ploughing through the alphabet, and trying to make Cocom understand what he is driving at. He tries to get from Juan a glyph for the letter *l*, and repeats "*e-le, ele*"—remember that he writes that the Indians had to be told that *l* has two syllables or letters. Cocom finally comes up with *elel*, to burn, and gives Landa the sign of the three hearthstones, symbol for fire in the Maya area from time immemorial. Landa misunderstands, and demands the symbol for *le*, noose or snare, for which Cocom supplies a glyph, very common in the codices (about 100 occurrences). Once it appears over what may be the *elel* element above a picture (Codex Madrid 91 *a*) of a bird caught in a snare. Cyrus Thomas (1893) and Knorozov consider this proof that this element does have the phonetic value *le*, but the same combination appears on the adjacent page 92 *a* above a picture of a deer caught, not in a snare (*le*), but in a deadfall (*petz'*). There is no noose at all. Of the approximately 99 other occurrences of Landa's *le* element, not one seems to belong in the fold with the one occupant pictured on Madrid 91 *a*. On the other hand the *elel* element appears several times above pictures of snares. Landa's *le* may well be both a snare and a delusion, but it cannot also be a deadfall.

To return to our early afternoon in 16th century Yucatán, Landa draws the glyph (Fig. 1 *a*) which now reads *elel-le-elel-le*, a most impossible Maya combination, and which he would have us believe is the Maya way of writing *le*. It is obviously the result of a misunderstanding perhaps brought on by loss of temper and Maya stubborness.

Practically the same thing happened with the attempt to write *ha* water. Landa clearly said *h-a, ha*, but as he pronounced *h* Spanish fashion as *achay* probably with a slight aspirate, he got the head of a turtle, *ac*, a tied-up length of cloth, pretty obviously standing for *hach'*, a term for tying up trousers or skirts with a sash

or belt, and for *ha* a badly drawn water symbol as can be seen by comparing it with water symbols at Chichén Itzá and at Classic sites (Fig. 1 *e*, *f*). Knorozov misidentifies this sign with the distinctive lunar postfix, assigning the latter the phonic value *ha* or, more frequently, *ah*.

Poor Cocom, quite at sea, had produced elements corresponding to *ac*, *hach'* and *ha* to represent *ha*, water; Landa, equally uncomprehending, had drawn them in his notebook. Cocom probably took the *hach'* sign, like *be* and *le*, leaf, from nontextual sources.

Nevertheless, there certainly is a strong phonetic element in Maya writing, but it is, I believe, very largely a matter of play on homonyms, in other words rebus writing (Thompson 1950: 46-7, 269-70, 289-91; 1958). However, that is a very different matter from an alphabetic or syllabic writing, although with time it might have developed along those lines.

Nahuatl and Hispano-Nahuatl Writing

We turn now to Nahuatl hieroglyphs in the knowledge that Maya culture did not flower alone, particularly in the centuries immediately before the Spanish conquest when deities, plants, elements of social organization and warfare (Thompson 1943: 23-4), and trade goods were increasingly interchanged. With such interchange a writing system approaching alphabetic or syllabic would surely have passed from one area to the other, and, even had it been rejected by the priesthood, it would have been accepted by the merchant guilds and the collectors of tribute. Part of what follows has been published by Valentini (1880), Leon (1900), and Tozzer (1911) but it is worth restating with new deductions.

There is no alphabetic or true syllabic writing in preconquest Mexican codices; this would easily be spotted had it existed because the glyphs are mainly of identifiable places and persons. There is a certain use of rebus writing. Codex Mendoza, an immediate post-Columbian copy in part of the Aztec tribute list, has pictorial glyphs and a few cases of rebus writing. For example, Tenantzinco, place of the little wall, is drawn as a parapet, *tenamitl*, and under it, the lower half of a human body, *tzintli*, to represent the homonym *tzin*, small. The locative *co* is omitted (Fig. 1 *g*). The postfix *tlan*, near, is commonly drawn as two teeth, *tlantli*. Mixtlan, near the clouds, is painted as a cloud, *mixtli*, below two teeth (Fig. 1 *h*). Note that to our European way of thinking the spoken syllables reverse the arrangement of the drawing; we would read it downwards as Tlanmixtli. Under Spanish influence Nahuatl writing showed a great increase in rebus writing, but it also developed in directions of which there are no indications in the pre-Columbian documents.

The present copy of Codex Xolotl, written a decade or two after Landa prepared (about A.D. 1560) his alphabet, well illustrates these processes. The Nahuatl authority Charles Dibble (1940, 1951) has made outstanding contributions to the problems of historical codices by his catalog and discussion of the glyphs in that codex and by his scholarly commentary on the whole codex. He notes (1940: 110-2):

> This is the only [nahuatl] codex in which there is an attempt to express a complete thought (phrase) with a series of hieroglyphs. This tendency, to the best of the author's knowledge, does not appear in codices made before the conquest. Codex Xolotl was written toward the close of the century of the conquest and Spanish influence is easily distinguished in the manner of representing objects (sun, moon, stars, flag, trees). This inclines the author to think that the combination of hieroglyphs to express a complete thought is an example of stimulus diffusion. (Translated from Spanish by J. E. S. T.)

Here the various glyphs which form the phrase are in line, just as in Landa's Maya sentence, but they are still pictographic, ideographic, or rebus writing; there is no attempt at anything approaching an alphabet. This same transition is well illustrated in the postconquest Codex of 1576, which in part derives from the preconquest Codex Boturini, but was written early in the 17th century. Long (1935) made the important points that the former contains far more examples of rebus writing than the latter and that it has the year glyphs, not placed as in Codex Boturini zigzag and often to be read from the bottom upwards, but arranged in blocks to be read from left to right, line by line, in European fashion. One might in passing note a charming example of rebus writing in this codex: the glyph of the great Viceroy of Mexico, Antonio de Mendoza, is a maguey plant, *metl*, over a rabbit (*tochtli*), there being no *d* in nahuatl (Fig. 1 *i*).

A word should be said about Testerian, a form of writing, largely pictorial, used until the 19th century for teaching Christian doctrine, and named after Jacobo de Testera, a Franciscan who reached Mexico in 1529 and is credited with its invention (Leon 1900). Seler (1904:

221-8) illustrates and deciphers one text; Tozzer (1911) illustrates another and gives full citations. Pictures, largely European in design and conception, served to teach the creed, catechism and so on. God Almighty is shown with European orb and scepter, or as a hand, a medieval convention for God the Father. The entrance to hell is the open mouth of a monster as in medieval "dooms," but closely resembling the Aztec cave symbol, the open jaws of the earth monster, a remarkable example of convergence. Ascent and descent are shown by a European ladder. Nevertheless, there are some native elements. The Aztec glyph for heart *yollotl*, stands for heart, and placed in the jaws of hell it may also stand for interior (compare Tepeyollotl, the heart or interior of the mountain).

In Codex Mexicanus 23-24 (Mengin 1952) mixed Testerian and rebus writing occur in an almanac for the year 1570. A fish stands for vigil, a candle over a mummy bundle (!) is the glyph for All Souls Day, a hand and the wounded side of Christ is the glyph for St. Thomas, and a grill by itself represents St. Lawrence, whereas in Europe one would expect the figure of the saint holding the grill. The concept is European, but the design (the mummy bundle, for example) is purely native, as are the rebus elements discussed below.

The friars soon put the Testerian system to general use, painting the pictorial stories on large charts for the instruction of out-door classes, and on folded sheets for individual study. At the same time they adapted the old Aztec hieroglyphic writing to their own needs for the instruction of the new converts, transforming it into a purely rebus system with a less restrictive choice of near homophones. This method had presumably been evolved before 1547, for it is described by Las Casas (1909, ch. 235) who left Mexico in 1547. In any case it was in use before 1555, the year in which Las Casas is generally thought to have completed his *Apologética historia*. Following a short note on pre-Columbian codices which he says he had seen, he writes:

> It happens at times that some Indians forget some words or details of what is preached to them of the Christian doctrine, and as they do not know how to read our writing, they write all the doctrine with their figures and characters, putting down the figure which corresponds in voice and sound to our word. Thus, when we would say *amen*, they paint one like gushing water and then a maguey which in their language resembles *amen* because they call it *ametl*, and so for all the rest. I have seen a great part of the Christian doctrine written in their figures and images, and they read it by means of these as I read a letter by our writing. This is an ingenious artifice by no means unworthy of admiration. (Translated from Spanish by J. E. S. T.)

Las Casas is slightly in error for amen is two syllables. Gushing water corresponds to *atl* (*a* in compounds); maguey is *metl*. In crediting this invention to the Indians, he gives, as always, the benefit of the doubt to the Indian when praise is due. Probably the credit should be shared by Indian and Spaniard, for the friars without much doubt built on Indian foundations.

This form of rebus writing — for example, *pater noster* was written as a flag (*pantli*), a stone (*tetl*, for there is no *r* in nahuatl), a prickly pear (*nochtli*) and again a stone (*tetl*) — is arranged, European fashion, in straight lines like the phrases in Codex Xolotl and in Landa's illustrative material.

Acculturation produced a remarkable burgeoning of hispano-nahuatl writing. Codex Sierra (composed 1550-64), for instance, has a mixture of pre-Columbian glyphs, Testerian writing, and new adaptations (Leon 1933). Year bearers — 7 Tecpatl, 8 Calli, and so forth — are pre-Columbian, but the glyph for Christmas, an open-sided shed or stable straight from Botticelli, is Testerian. The use of the cursive A year symbol with numerical dot to indicate a *period* of one year and the formation of a sign for 10 by slicing in half the flag (nahuatl symbol for 20) and the object over which it flies are mental advances the pre-Columbians never made. A charming example of acculturation in another document is a hand holding a large iron key as the name glyph of Juan Tlatlin, for *tlatlati* means he who hides, shuts up or guards a thing (Seler 1904: 217). In Codex Mexicanus 23-24 (Mengin 1952), alongside Testerian writing, is the head of a bird (*tototl*) below what seems to be a plant (*centzontli*) of maize as the glyph for All Saints Day; *toto centz* is not a bad rendering of *Todos Santos*. Perhaps because of language difficulties this shift of vowel from *e* to *o* marks a very rare deviation from pre-Columbian practice, but in compensation for that laxity the enclosing consonants of the syllable are unchanged. Note the inversion, as in the glyph for Mixtlan, the *santos* being above the *todos* glyph.

The Valades alphabet (Brinton 1886) need not detain us. It was a stillborn child of pure

European parentage, having had no influence on hispanic-American systems. The whole point of the friars' use of rebus and Testerian writing was that an alphabetic writing was something beyond native ken.

In summary: rebus writing, relatively rare in pre-Spanish documents, proliferated when it was taken over and expanded by the friars to spread Christianity. A glyph came then to represent, not a complete syllable, as was the pre-Columbian ideal, but only the opening consonant and vowel (for example, *metl* standing for *men*, *nochtli* for *nos*), but — and this is an extremely important point — even with this relaxation of rules, the maguey (*metl*) glyph, for example, could not stand for the letter *m* alone or the sounds *ma*, *mi*, *mo* or *mu*; it could stand only for *me* plus any final consonant. Very rarely, the vowel could shift, but then the enclosing consonants were inviolate.

Testerian writing, which had its counterparts in pre-Columbian picture writing (for example, shield and spear and burning temple as symbols of war and of conquest) was widely used by the friars. It was accepted by educated Indians and appears side by side with regular nahuatl glyphs and hispano-nahuatl innovations. Of the last several examples have been noted. Old symbols are given extended meanings or undergo modification; glyphic elements are written European style in straight lines; and in Codex Xolotl glyphs express regular phrases.

Hispano-Maya Writing

Landa, unfortunately, is our only source for postcontact Maya writing. Other examples must have existed for Ciudad Real, writing some 20 years after Landa, says that some friars learned to read and even write the Maya glyphs. Assuredly, they were not writing the usual calendar and ritual of the codices, but had evolved a *pater noster* type of writing for indoctrination.

The same tendencies we have noted in hispano-nahuatl are discernible in Landa's hispano-Maya. The manipulations, so far as we can follow them in his alphabet — *aac* (turtle) for *a*; *zec* (month sign) for *ce*; *ne* (tail) for *ene* and so forth — conform to what was happening at the same time in central Mexico. Glyphs are made rebus fashion to represent the sound, but an opening vowel or, as in hispano-nahuatl, the final consonant of a syllable could be ignored. There is no evidence that the rules of this writing, whether invented by native priest or Spanish friar, allowed *be* (road), for example, to stand for *ba*, *bi*, *bo*, or *bu*, or for sounds beginning with *p*. Signs almost unknown in pre-Columbian texts are promoted to "alphabetic" rank, surely a very strong argument for its non-Maya origin.

The hispano-nahuatl arrangement of glyphs in straight lines occurs in Landa's single supposedly Maya phrase. The five glyphic elements corresponding to the Maya *ma in kati*, I do not wish, are not clustered, Maya style, as affixes around one or two main elements, but are in a straight line, a presentation as Spanish as Don Quijote or the Guadalquivir (Fig. 1 *c*). No Maya could possibly have written them that way; the *ma* and *ti* would have been affixes, the first above or to the left of the main sign, the last below or to the right, but touching the main sign and with changed axis.

We can also detect accultural innovations. Elements are attached to many of the month signs which Landa draws. What these represent is not clear — that before Cumku looks rather like the fire drill glyph — but in Maya usage month signs are always completely isolated except for their numerical affixes. Elements before a Maya month sign are as out of place as a designation in the British peerage before the name of a president of the United States.

Landa's Alphabet as a Rosetta Stone

Landa's *Relación* was published in 1864. In short time several writers had seized the alphabetic key and with it read the hieroglyphs, each to his own, but to no one else's satisfaction. Interpreters were handicapped by failing to realize that the Maya sound corresponded to the name of the letter, not to the letter itself. For instance, *c* could not stand for *c* hard but only for the sound *say* (Thompson 1953). Because of the extreme rarity in Maya texts of several of Landa's alphabetic signs, each interpreter was impelled to supplement Landa's Holy Writ. These numerous attempts to make silk purses out of Landa's sow's ear ended in disaster; the extravagances of the decipherers, growing with each failure, shrouded in clouds of fantasy the three or four reasonable decipherments. Both alphabet and phonetic system were thoroughly discredited. No one, then or since, has taken seriously Landa's queerly constructed glyphs for *le* and *ha*; each accepts his alphabet, but rejects his demonstration of how it is used!

Fifty years later, Benjamin Whorf (1933, 1942), declaring that only a trained linguist could tackle the glyphs, retrieved Landa's alphabet from the attic, and added to it. The Maya, he claimed, would have spelled *cab* with glyphic elements representing *c-a-b* or *ca-b*. The glyphic element *ca* could stand for *ca* or for *c*; it could not, he maintained, be used for *cu*, *co*, *ce*, or *ci*. His attempt to read the codices also bogged down in failure. His second (posthumous) paper revealed no noticeable progress in the eight intervening years (Thompson 1950: 311-3), whereas, if a system is alphabetic or syllabic, one must progress with gathering momentum after the first decipherments have been made. Whorf's ideas found no acceptance, and have been forgotten.

Recently J. V. Knorozov (1952, 1953, 1955, 1958a, 1958b) claims to have solved the problem with what he terms a Marxist-Leninist approach, basing his work on Landa's alphabet.

THE KNOROZOV APPROACH

Knorozov bases his work on the Landa alphabet but he, too, treats it eclectically. Landa carefully distinguished between letters with and without glottal stop, carefully giving glyphs for *p* and *p'* and for the velar and palatal *ka* and *ca* and *ku* and *cu* in accordance with Maya practice; Knorozov discriminates or not as the fancy takes him. He pays no attention to the inescapable evidence that Landa was naming, not pronouncing, the letters of the Spanish alphabet, and so reads the Spanish *c* (pronounced *say*) as a hard *c* and even as a *k* (velar) in *kek*. Landa's *l* (*ele*) is identified as a glyph to which the sound value *lu* is given. Like others, Knorozov ignores the examples of word formation which Landa gives.

Basically, the system is that one constructs a monosyllabic word (to simplify matters I shall discuss only the more numerous consonant-vowel-consonant words) by taking a glyphic element which corresponds in sound to the opening c + v and adding to it a second glyphic element the first letter of which corresponds to the last consonant of the word to be formed. Thus, one would write *cab* as *cat* for *ca* and *bat* for the final *b*, choosing for the final consonant a glyph with the same middle vowel. This is what Knorozov terms synharmonic construction, but there are so many exceptions to it (for example, *mu-ti* read as *mut*, *mu-ca* as *muc*) that it can be ignored.

There are also many exceptions which Knorozov makes to his own rule that the first glyphic element rigidly adhere to the c + v of the sound value. Thus, Landa's *ma* sign is read as *mo* in *mok* and as *na* to make *napahan*; the *yax* affix is read not only as *yax* but as *hal* in *itzhal* and as *hol* in *cahol*; Knorozov's *nal* becomes *mal* in *oxpocmal* and *mol* in *molhal*; his *om* is *om* in *olom*, *an* in *napahan*, and *hun* in *hunabah* (although the Motul dictionary lists *hun* with intensified *h*); *chac* (red) can also be read *ta* as in *takan* (but *chac* does not shift to *ta-* in any Maya dialect); the hand glyph is both the God Chac and *chuc*; the affix read *pidz'* becomes *p'iz* in *et p'izan* (a remarkable shift) and *pedz'* in *pedz'kin*; *kin* becomes *cun* in *yaxcunah* and so on. Clearly, one has much freedom in the matter of the vowel. (Note that in two or three cases Knorozov gives the impression that these variations in spelling are Maya, for example, that *pidz'kin* is a Maya variation of *pedz'kin*. Such is not the case; they originate with Knorozov.)

A doubled element can be read as a single, as in the reading *takan* where two *kan* signs are present, or can be repeated as in *cu-cu* to give *cuc* or *ce-ce* to form *kek*. Phonetic elements can be passed over, as with the *n* element after the name glyph Chac or an affix may be added to reinforce the reading, as the *na* element added to the *tun* sign to indicate the *tun* ends in *n* — *tun-na* equals *tun*.

The order of reading in a system of this nature is obviously of the highest importance, but here, again, there is no hard and fast rule. Normally, the order is left to right and top to bottom, and if there are two postfixes the one below is read before the one to the right. In the case of the glyphic compound read *cutz*, a reversal of order produces a reversal of sound, and the glyph is read *tzuc* (Knorozov 1958: 288). Elsewhere (1958b: 469-70) he tells us that the arrangement may conform to esthetic considerations. The glyph *mu* above *ti* is read *mut*, but the order is not infrequently reversed, and one would suppose it should be read *ti-mu*, *tim*, but this supposition is incorrect; this is to be read *mut* also. If that reversal of order is of no consequence, if one can read it either way and shift an occasional vowel, one is obviously playing the game of decipherment with deuces wild. This brief outline oversimplifies Knorozov's ideas, and in fairness to him readers should read his papers. As Knorozov (1958a: 286)

claims to have deciphered the glyphs after a century of others' failure, his achievement merits discussion. I propose: *a*, to review his use of source materials; *b*, to criticize his technique of decipherment; *c*, specifically to compare decipherments of two glyphs as read by him and by me, both being vital to my approach and important to his, and to dwell briefly on a third glyph in the same category; *d*, to discuss two readings equally vital to the Knorozov approach; *e*, to analyze his translation of a single sentence. First, I would urge careful study of the views expressed by Barthel (1958).

Source Materials

Knorozov depends for Maya on the excellent Motul dictionary and the quite unreliable Brasseur de Bourbourg vocabulary, of which Brinton (1882: 75) wrote: "I can say little in its praise. . . . it contains about ten thousand words, but many of these are drawn from doubtful sources and are incorrectly given." Among words which Knorozov matches with glyphs and, following de Bourbourg, assigns quite incorrect meanings, are: *bilah*, *cech*, *im*, *in* (*in coch in*) *kahol*, *moc*, and *tz'anacul*.

Furthermore, Knorozov invents meanings for Maya words. He reads a glyph *cumchabah* (the terminal *ah* is the lunar postfix he wrongly identifies as Landa's *ha* reversed to sound *ah*). This, he tells us, is the same as the modern *cumcabtah*, to seat, citing the Motul dictionary. It is followed by a common maize compound, and he reads the pair as "sows the maize" (Knorozov 1955: 87, No. 141; 94, No. 13). For *cumcabtah* the Motul gives the translation, "set jars, vases, and such like things on the ground." *Cum* is a storage jar, *cab* is earth, *t* is the sign of the agent, and *ah* a verbal termination. Thus the incorporative word for setting a jar on the ground is rendered as sow in reference to maize! *Oczah* is the common Yucatec word for sow; to plant is *pak*.

Knorozov reads the last word in this same sentence (No. 13) as *ti ch'abtan*, which he translates "at a happy time." *Ti* is the locative; five entries in the Motul dictionary cover *ch'abtan*. Four translate it as continence, fasting, penance, abstention from the delights of the flesh, and observant of God's laws; a verb *ch'ab* has the same meanings. The fifth entry, a fortunate thing, has as its illustration a phrase translated "fortunate (*bien aventurado*) the souls of those who keep God's commandments." It is highly probable that the clerical author either made a slip here or used the word because those who had all the Christian virtues comprehended in the word *ch'abtan* necessarily had blissful souls. Knorozov drops no hint that elsewhere there is no association of the word with happiness, and that certainly there is no reason to suppose it could mean happy time.

Again, the meanings Knorozov assigns to *macaan*, *kinanhal* and *bat u cah* in Examples 12 and 14, on each side of the above citation, are spurious. Space restrictions prevent analysis of these and quite a few other demonstrable distortions of grammar or meanings. Impossible translations of *u muc*, *ox ocaan*, *icham*, and *zac ch'up* are discussed below.

Techniques of Decipherment

A number of compound glyphs, all the components of which have been assigned sonic values by Knorozov, do not appear among his decipherments, although they obviously ought to be excellent proof of the soundness of his method if they did make sense. I have tried my hand with some, using Knorozov's sound values, but the results were meaningless. Knorozov himself makes little attempt to see whether the value assigned a glyphic element fits in other contexts; when he does, the meanings may be so forced as to be useless. For example, the suffix in Figure 1 *k* is assigned the value *an* or *aan*. This element is postfixed to the month signs Pop, Zec, Kankin, Kayab, and once to Muan (this case apparently gave Knorozov the reading *an*). To account for these he reads Pop, which means mat and has a mat pattern in it, as *ch'acaan*, chopped down with ax, and this is referred to clearing milpa. Kayab is reread as *aakaan*, fresh or damp, and is said to be month of fresh or green grain. There is not a tittle of evidence for such translations. Moreover, Kayab, month of green corn, falls two months before Pop, when the land is cleared for planting!

This same *aan* element affixed to the *kin*, sun, sign with Ben Ich prefix is the well-known glyph of the sun god. Knozorov reads this as *kinaan*, he who rules. *Kin* can mean to rule; *aan* is a past participle termination. The Motul dictionary gives the meanings something half warmed (sun heated) and a thing which rules, reigns and is prevalent. Use of the word *cosa*, thing, and the example, the pest prevails, illustrating *kinancil*, to reign or rule, make it ob-

vious that this is not personal rule, but is to prevail, one of three meanings given for *reinar* in the Royal Academy dictionary. To translate thing which prevails as he who reigns, is to play ducks and drakes with Spanish and Maya. Another incorrect use of this termination will appear in discussion of *ox ocaan*.

The Subject Matter of Codices Dresden and Madrid

A brief outline of what is known of the contents of the Maya codices is pertinent at this point. Early sources report that the Maya recorded in hieroglyphic books their histories and prophecies, which in the Maya thought pattern are interwoven; Codex Paris carries a series of katun prophecies. Planetary and eclipse tables in Codex Dresden surely have a divinatory function, and the many 260-day almanacs, divided into compartments, which occupy the greater part of the Dresden and Madrid codices have been recognized as divinatory from Förstemann (1895) to Zimmermann (1956). The *Relaciones de Yucatán* (Vol. 2: 210) recount that priests had books of figures indicating times to sow and harvest, to go hunting or to war. This same pattern of interwoven history and prophecy, of astronomy, and of 260-day almanacs listing lucky and unlucky days occurs also in the books of Chilam Balam, the lineal descendants of the hieroglyphic codices. The evidence is overwhelming that the 260-day almanacs in the two codices (they number about 300) give the luck of the day for such matters as hunting, planting, beekeeping and disease. Decipherments of associated glyphs must conform to that pattern.

A Pair of Contrasted Glyphs as Deciphered by Thompson and Knorozov

A few years ago I established, at least to my own satisfaction, that the glyphs in each compartment of most divinatory almanacs conformed to a general pattern (Thompson 1950: 263-73). Students had been working toward this solution for many years, and perhaps my task was to dot the *i*'s and cross the *t*'s. Generally, each compartment holds four glyphs: (1) an action or verbal glyph; (2) the name glyph of the god ruling the days in question, usually the subject; (3) sometimes an object; (4) the last glyph or pair of glyphs recording the augury resulting from the action or influence of the god — abundance, drought, good times, misery, and so forth. There is a clear pattern: certain augural glyphs occur with good gods; others, notably the death glyph and the one I named the *kaz* or evil glyph, occur with the death god and the evil God Q. These associations had been partly perceived by Gates (1931); they were worked out more fully by Zimmermann (1956) with his positive (good) and negative (bad) groupings. Barthel (1953: 45) certainly accepts the general thesis of divinatory almanacs, of action glyphs, and resulting augural good and bad glyphs. There is, therefore, much agreement on this side of the world on the divinatory nature of most almanacs in the codices. Any general interpretation of glyphs should conform to this divinatory pattern or reasons should be given for rejecting these categories which have gained wide acceptance.

The two chief augural glyphs are, according to my interpretation, the symbol for evil or misery and that for what I term very good tidings (Fig. 1 *j*, *k*).

Schellhas (1904: 13), 60 years ago, said our evil glyph, usually found with Gods A and Q, "relates to death and the death deity." Tozzer and Allen (1910: 338) note "it is the representative in many places of God A, the death god." Gates (1931: 127) saw it as "a determinative of the 'evil' force active." I (Thompson 1950: 268) identified it as the augural glyph of evil and misery, probably corresponding to the Yucatec *kaz*; Zimmermann (1956: 705) lists it in his negative (unfortunate) category. Here is close agreement.

My very good tidings glyph occurs nearly 100 times in the codices, nearly always with benevolent deities such as the rain gods, the maize god and God K; it is never with the death god's glyph or above his picture or with the glyph of death. Gates (1931: 58) noted its occurrence "over 90 times, in connections 'of good omen,'" and suggested the reading *oxtescun*, thrice greeted, a formal salutation in prayer. Zimmermann places it in his positive (favorable) category. I pointed out that the number three, *ox*, in front of the sign was almost certainly to be read as an intensifier, practically our English "very." Rejecting *och*, sustenance, for the Oc main sign, I opted for something like very good tidings (Thompson 1950: 268-9).

Here, then, we have two glyphs shown by their contexts to be exact opposites, bad and good, death and life, or something similar,

which appear largely in divinatory almanacs, usually at the close of each section where the luck of the day is to be expected. Clearly, they correspond closely to the *utz* or *malob*, good, and *lob*, bad, or the rarer *kaz*, evil, written beside the days in the divinatory almanacs of the post-Columbian books of Chilam Balam.

Knorozov (1955: 94, 95) reads my evil glyph as *u muc*, this time, and my very good tidings glyph as *ox ocaan*, frequently, or habitually, but his Maya constructions leave much to be desired. *Muc* is a numerical classifier. Beltrán, compiler of a list of numerical classifiers, says that *muc* after a number signifies single, double (*el tanto y el duplo*); the Motul dictionary says times (*veces*) and lists *hun muc*, *ca muc*, once, twice. There is doubt as to whether *ca muc*, for example, signifies two occasions or double because of the ambiguity of Spanish *vez* and English *times*. According to Beltrán it means double. In any case, *u muc* cannot mean this time. *U* before a noun is the possessive, and conceding that *muc* could be a noun, the compound should be followed by the glyph of the possessor, but usually it has no glyph after it; it is the last glyph in the compartment. On the unverifiable assumption that *muc* is also a noun, it could only mean his time (occasion) or her time or, more probably, his multiple. This glyph is never joined to a number which would be its normal use were it, indeed, the numerical classifier *muc*. Knorozov follows early authorities in identifying this little head as that of an owl. As a variety of owl is called Muan he gives the main element the sound value *mu*. He has overlooked a long article by Beyer (1929) with over 100 drawings which showed conclusively that the little head is not that of an owl. Clearly, the reading this time is based on a misidentification of a glyph and misunderstandings of the nature of Maya numerical classifiers and of the *u* element.

The reading of my very good tidings glyph (Fig. 1 *k*) as *ox ocaan*, frequently or habitually, is based on the main element being the day sign Oc. Knorozov follows me in choosing for the numerical three (*ox*) its secondary use as an augmentative, much or very. He reads the postfix as *aan*. *Ocol* is to enter as to enter a house; *ocaan*, its past participle, is something or somebody which has entered, which is inside, and it is used figuratively — sin has entered my heart, or Chac (the rain god) has entered, that is, the rainy season has begun. *Ox ocaan* could perhaps mean much entered, but there is no conceivable reason to suppose it can mean frequently or habitually.

Accordingly, of Knorozov's two readings, *u muc* is meaningless, while *ox ocaan* can be rendered much entered, whatever precisely that may signify, but it cannot be given his interpretation of frequently or habitually. Even were those two readings linguistically acceptable, an explanation should be forthcoming as to why "this time" is confined to phrases involving malignant gods and "frequently" to those associated with beneficent deities. Nor is the combination of the two glyphs on Dresden 65 *a* (Fig. 1 *l*) explained, for this time and habitual sort ill together. In my case the explanation is logical. *Kaz* has a homonym meaning somewhat or partly. Partly good tidings (the *ox* augmentative is here absent) is a perfectly good Maya augury. Indeed, days are thus labeled in almanacs in the books of Chilam Balam.

To dissect in that way every decipherment by Knorozov would quickly exhaust the patience of editor and reader, but I submit that those two readings well exemplify the violence Knorozov does to the Maya language to obtain a meaning, that they reveal his disregard for all that is known of context and subject matter, and make evident his failure to test his translations against other occurrences of the glyph or its elements.

In passing, one may note that Knorozov assigns the sound *mu* also to the spiral element of the glyph which I read as *koch*, disease or divine punishment, and its homonym *koch*, carry on one's head or shoulders (Thompson 1958).[1] Knorozov interprets these signs also as *u muc*, this time; as *mut*, totem, when the locative *ti* is present above or below it. Here is a case where our interpretations meet head on.

Glyphs for Dog and Turkey

In all his papers Knorozov (for example 1958a: 288; 1958b) cites his readings of the long recog-

[1] There I overlooked remarks by Napoleon Cordy (1946) on this subject. We both apply *koch*, the only term that fits, to the actions shown in those passages. There the parallel ends. Cordy takes what is for me the locative *ti* as the sign of the vulture, *kuch*, and reads it *cuch* or *koch*; I read the spiral element as *koch*. Cordy was demonstrating that in Maya writing *o* and *u* and *c* and *k* can be interchanged, an approach I oppose; I see the whole as a pictorial and glyphic rebus for *koch*, disease, views Cordy did not touch on.

nized glyphs for dog and turkey as fundamental advances along the path of phonetic decipherment. Let us examine them.

The glyph for dog (Fig. 1 *m*) has two elements. To the first, widely thought to depict the thorax, Knorozov assigns the sonic value *tzu* (from *tzuulbac*, backbone); the second he identifies as Landa's *ele* glyph and reads it as *lu*. The whole forms *tzulu*, that is *tzul*, dog. There are four strong arguments against this reading: (1) *tzul* is a rare term for dog, (2) the element read as *lu* is almost certainly not Landa's *l* (*ele*), (3) the order of the two components is once reversed, (4) there is good evidence the compiler of the Dresden codex assigned the value *pek* to this sign.

The common Yucatec word for dog in general is *pek*; *tzul*, defined as a domestic dog, appears only in the Spanish-Maya part of Motul and in the San Francisco dictionaries, both believed to be rather late compilations. *Tzul* is not the ancient term for dog (*tsi* in most Maya languages), and does not occur in the books of Chilam Balam, where *pek* is invariably used for dog.

The second part of the dog glyph almost certainly is not Landa's *l*, but is Beyer's gouged eye, a common glyphic element (Fig. 1 *n*). Förstemann thought it a symbol of sacrifice, as does Barthel (1955: 17); Lizardi (1948) sees it as the glyph of human sacrifice. It always has the comb element or a cross-hatched area infixed in the middle. Landa's *l* (Fig. 1 *d*) lacks this characteristic infix, but has, instead, a line bisecting the drawing, rather like the medial vein of a leaf. Leaves are not common in Maya art, but I give a selection (Fig. 1 *o-r*). It is a reasonable supposition that Landa's Maya informant drew a leaf (*le*) for the Spanish *l* (*ele*). Whether it is a leaf or not, is not the gouged-eye glyph and should not be confused with it.

Knorozov (1958a: 288), as noted, finding the two elements of his *cutz*, turkey, glyph in reversed order, reads them as *tzuc*, heap or division, and on the next page this decipherment is cited as evidence for the correctness of his approach. On Dresden 39 *a* above a picture of a dog is a damaged but still legible example of the dog glyph, but in reversed order, the supposed *lu* is to the left and the supposed *tzu* to the right. Logically then Knorozov must read this as *lutz*, fish hook, and explain why a fish hook is the name glyph of a dog.

Apart from these arguments against the reading *tzul*, the Chilam Balam of Chumayel supplies excellent grounds for reading the sign as *pek*, the usual term for dog. In the prophecy for Katun 3 Ahau (Roys 1933: 154) we read: "The dog (*pek*) is its tidings. There are rains of little profit, rains from a rabbit sky, rains from a gourd-rattle sky, rains from a woodpecker sky, high rains, rains from a vulture sky." Rain from a rabbit sky is a known expression for drought; gourd-rattle Chacs, still alive in Maya folklore, make much thunder but little rain. Clearly, *pek* is a symbol of drought.

This is confirmed by the entries for Katun 1 Ahau, of which it is said "*pek* is its tidings; the vulture is its tidings." The prophecy continues with prophecies of drought, of pestilence, and of vultures entering the houses (a stock phrase for death sweeping the country). In the small picture of the katun there is a drawing of what assuredly is a dog. Roys (1933: 154) notes that a second meaning of *pek* is water tank or reservoir, and the tidings may have been the water tank because these had to be used in times of drought. *Pek*, dog, therefore stands for its homonym *pek*, water reservoir. On Dresden 39 *a* and 40 *b* this dog glyph appears above pictures of a dog with blazing torch in each paw (the blazing torch is a common symbol for drought and extreme heat). Both are in compartments of almanacs which clearly treat of farmers' weather, for in other compartments there are glyphs for drought and contrasting pictures of the rain god standing or sitting in the rain. One picture is of a vulture in the rain, a graphic parallel to the prophecy of rains from a vulture sky. The dog with his torches must be *pek*, the *pek* tidings of drought, probably rebus writing for the homonym *pek*, water tank, symbol of drought. Read as *tzul*, the drought association is completely lost.

On all four counts *tzul* is a most improbable decipherment. Moreover, if my thesis of disease divination is correct, the dog glyph is used rebus fashion for *pek*, a skin infection (Thompson 1958: 305); there is no *tzul* disease.

The second occurrence of this supposed *tzu* sign is with the Cauac glyph, Landa's *cu*. As this appears once above a picture of a turkey cock (Madrid 91 *a*) Knorozov follows Cyrus Thomas in reading it as *cutz*. The usual Yucatec term for the wild (ocellated) turkey cock is *ah tzo*, found in various Maya languages, or *ah tzo cutz*. *Cutz* and *ixch'ich'* or *ixch'ich' cutz* are names for the hen (*ch'ich'* is a generic term for

bird). *Ulum*, now used for the domestic turkey, and *cahmal*, a sacrificial turkey, are other terms. Turkeys are mentioned nine times in the Chilam Balam of Chumayel; *ah tzo* and *ulum* four times each and *cutz* once. There *cutz* is paired with *ah tzo*, and the context (Roys 1933: 39) shows it to be female. The Maya, excellent observers, would hardly have drawn a male bird and labeled it with the glyph for the female.

This ribs glyph is distinctly one of the rarer Maya signs, whereas *tz* is a very common Maya sound. If the glyph does have that sound value, why is it so uncommon? It may be more significant that the only pictures with which it occurs are dog, turkey, and fish, all sacrificial offerings.

Analysis of a Sentence

To conclude this discussion, I shall analyze a sentence translated by Knorozov (1955: 45, No. 23) comprising four glyphs (Fig. 1 *u*) which he reads: (1) *hicham*, the married; (2) *ch'up*, woman; (3) *zac ch'up*, [is] a sterile woman (literally, white woman); (4) *ox ocaan*, frequently.

Glyph 4 is my very good tidings already discussed. Glyphs 2 and 3 have been recognized for the past 70 or 80 years as representing woman or goddess. I regard her as the moon goddess, Ixchel, the mother goddess. Her divinity is apparent in various scenes. For instance, on Dresden 22 *b*, seated at the north, she is one of the four-world directional deities. On Dresden 38 *a* she is in an allegory of the rain god making fecund the earth. Were she mortal the scene would be more Greek than Maya; a Jovian eye for mortal pulchritude is hardly in the Maya tradition. However, this is not a serious disagreement; Knorozov has merely taken the less likely choice between goddess and woman. *Ch'uplal* or *ch'up* is the common Yucatec term for woman in general.

When the *zac* sign, long identified as such, is affixed to the glyph, Knorozov reads it *zac ch'up*, sterile (literally white) woman. *Zac*, white, has a homonym *zac*, pseudo or artificial. I myself have read this affix as pseudo in the glyph *zac cimil*, severe epileptic attacks (pseudo death). *Zac* does not mean sterile. Knorozov seems to have derived that meaning in a wholly unwarrantable fashion from an entry in the Motul dictionary: "*zac yaom*, woman, mare or bitch who appears pregnant because of a large belly, but it isn't pregnancy." *Yaom* is *pregnancy*; *zac* converts it to false pregnancy. One can't divorce *zac* from *yaom* and read it as sterile when it is with the glyph for woman; *zac ch'up* can only mean a white woman or a pseudo woman, whatever that may be. The Yucatec word for sterile is *ixmaal*, she not child. For me, the glyph is that of the moon goddess, goddess of weaving, one of whose names was Zac Ixchel. *Zac* may refer to her weaving activities as it is the root of *zacal*, to weave.

Knorozov reads Glyph 1 as *hicham* (modern *icham*), married. Elsewhere he assigns the sound *hi* to the affix to left, *ch* (*a*) to the crossed band element, and *am*, *om*, *un*, *hun*, and *-m* to the suffix. The aspirate occasionally disappears after a consonant, but very, very rarely is dropped at the start of a word. I see no evidence that *hicham* is an early form of *icham*; Yucatec *icham* is not even related to the word for spouse in most Maya languages. Moreover, as Knorozov accepts Codex Dresden as Yucatec, it is a strange supposition that *i* is expressed by the *hi* sign when Landa's *i* was available.

Icham means not married, but husband; *atan* is Yucatec for wife, specifying the husband; *atanbil* is married woman in general. *Icham* can only be applied to a woman in roots carrying the idea of getting her man: *ichamben*, husband worthy, is a marriageable woman (*ben* as a suffix is worthy); *ichamancil*, to take a husband, is intransitive and cannot be converted into an adjectival form; *ah icham*, husband owner, is a term for married women, just as *ah atan*, wife owner, is a term for married men, but here *ah*, related to or owner of, is the key term (*ah* is a gender prefix only with certain categories of words), just as *ben* is in *ichamben* and *ancil* in *ichamancil*. Obviously, *icham*, husband, cannot mean married in reference to a woman, and the supposed glyph for *icham*, without additional qualifying affix, can no more stand for *ah icham* than in English, for example, the word husbandless can be read husband. Furthermore, in other sentences Knorozov reads exactly the same glyph as *icham*, husband. Unfortunately, much space is wasted correcting these many perversions of straight-forward meanings of words. They cannot be due to Knorozov's inability to understand the Spanish of the Motul dictionary, for he has translated Landa from Spanish into Russian.

Incidentally, Knorozov (1955: 77, No. 3) reads a glyph *ah achan* (*ah-a-cha-n*), and this

is said to be an archaic form of *ah atan*, married man. I am flattered that elsewhere Knorozov has followed me in my theory that the shift was *t* to *ch*, not *ch* to *t*, as linguistic opinion has supposed, but he can't have it both ways. If *te* becomes *che* in modern Yucatec, *achan* can hardly have been ancestral to modern Yucatec *atan*.

To summarize: (1) the construction of *icham* with an aspirated *hi* affix is very unlikely; (2) *icham* means husband, not married; (3) even were it read *atanbil*, wife, it would not precede the word (and glyph) *ch'up*, woman, any more than we would say wife woman in English; (4) *zac ch'up* cannot be translated sterile woman, but only white woman or pseudo woman; (5) the final glyph, *ox ocaan*, cannot mean frequently, but might be rendered much entered; (6) accepting Knorozov's sound values, the best reading would be: husband of a specified person, woman, pseudo woman, much entered.

The next compartment is the same except that the death god replaces *ox ocaan* as the fourth glyph (Fig. 1 *v*). This must read in the Knorozov system: husband of a specified person, woman, pseudo woman, death god. Even conceding that glyphs and sounds are correctly matched, I am at a loss to comprehend the divinatory aspects of these decipherments.

Examples I have discussed are not weak chinks in Knorozov's armor; they are typical of all his work. I can duplicate or triplicate this whole section with completely different examples of his errors in grammar, in word meanings, and in glyph usage. Linguistic references have been confined to Yucatec because practically all the glyphs discussed above occur only in the codices, not in early texts.

Future Research

No fire-faced prophet brought me word which way behoved me go, as Housman puts it. I can claim neither to have deciphered the Maya glyphs nor to know of any system to replace the one I have attacked, for I suspect that Maya writing, like Topsy, just grew. Rebus writing surely is a most important factor and rebus pictures also. Clearly glyphic elements represent both words and syllables (often homonyms). There are ideographs, glyphs with roots in mythology, and bits and pieces of half a dozen other attempts to write.

Best hope of progress perhaps lies in matching affixes with sounds. This is not an easy matter for clearly the proposed sound must fit wherever the meaning is known of the main sign to which it is attached. The difficulties are best shown by an example.

The postfix on the right of the second glyph (goddess) in Figure 1 *v* is a common glyphic element. In the codices it is most frequently used: (1) postfixed to the head of the moon goddess, as just noted; it is not always present; (2) almost invariably postfixed to the hand which forms the glyph of God B; (3) usually attached to the head variant of the dog; (4) often beneath the *uinal* sign; (5) often below offerings of maize, meat, fish, and so forth. Note that in no case is it indispensable, and it is not used as a prefix in the codices. The problem is to find a value which will fit all five cases.

The best answer seems to be *bil* or *uil*; the two sounds are used because *uil* replaces Yucatec *bil* in some Maya languages in its chief employment, to form a past participle. *Bil*, added to some relationship terms, generalizes them, for *na* is mother; *nabil*, mother without specifying whose. *Nabil* or *Coolelbil*, mistress, fits the glyph of the moon goddess, who was regarded as mother of mankind and is thus addressed. *Kab* is hand and *kabil* is one who is a good sower or beekeeper. God B, whose glyph is the hand, appears sowing in several pictures, and without his rain the crops fail. *Kabil* would be a good name and glyph for him. Presumably the Maya did not object to writing *kabil* as *kabbil*. *Bil* is the Yucatecan term for the hairless dog; this affix might be added to show that the hairless dog was meant. *Uil* means food, and so reasonably the affix could appear below food offerings. It also means month, and so the affix could appear under the *uinal* sign to indicate its use as a month sign, for it is used elsewhere in contexts which call for another meaning.

The score is quite good, but I am not sure it is good enough. Unfortunately, one is left in doubt. *Tzil*, a term of reverence, and *zil*, offering, also fit after a fashion, but I hesitate to make *tz* and *z* interchangeable, for that is a slippery path to descend. We are left in doubt until more evidence is available. *Kat* for the cross bands (Knorozov's *cha*) and *tan* for Landa's *ma* are other possibilities, but in our present knowledge of Maya glyphs, they cannot be made to fit all appearances. Mythological associations might help, did we know them better. Meanwhile, prudence bids us not to smother research with unproved conjecture.

Man always welcomes simple explanations for difficult things and sets of rules for the unruly, but things are never quite what we suppose, and an orderly, logical solution is improbable when dealing with the unregimented Maya.

Summary

The pre-Columbian hieroglyphic system of the Aztec and related peoples made a quite limited use of homonyms, but had no phonetic writing. With Spanish stimulus, rebus writing expanded greatly and old rules were loosened. A glyph which formerly had represented a complete word or syllable now stood only for the opening vowel and consonant. Glyphs were written, European fashion, line-by-line, and to be read left to right. Glyphic affixes were similarly rearranged in line. Landa's alphabet and sample words conform to this hispano-nahuatl style. Alphabet signs are of the consonant and vowel type, and glyphic elements are arranged in a straight line in a thoroughly un-Maya arrangement. This was because Landa, supposing the Maya had evolved a similar system, tried to elicit it from his bewildered informant. The latter, completely at sea, produced the signs demanded, but some were so uncommon they could never have played the parts assigned them in a supposedly phonetic system.

The Landa alphabet has proved a poor crutch. Recently, in the face of the failure of all previous attempts to read the glyphs phonetically, Knorozov has again tried that approach. Results are not promising. Many Maya words Knorozov obtains for his readings do not have the meanings he assigns them. To cite two examples, *cumcabtah* which means to place a jar (*cum*) on the ground (*cab*) is rendered to sow maize; *ox ocaan*, which can only mean much entered, is translated habitually or very frequently. Even readings thus obtained bear no relation to the subject matter. In a key demonstration of his phonetic approach he reads the glyph for dog as *tzul*, a rare term, but there is much evidence it should be read *pek*, the common Yucatec word for dog.

A complete sentence read by Knorozov as "the married woman frequently is sterile" is analyzed. Accepting all his readings, his Maya translation can mean only "husband, woman, pseudo (or white) woman, much entered." In largely monosyllabic Maya it is easy to match sound to glyphic element if one ignores differences between glottalized and non-glottalized sounds, ignores aspirates, postulates without any evidence supposedly archaic forms (for example *mahal* claimed as archaic form of *nohol*) and permits vowel shifts; the difficulty is to make sense of the words thus obtained. It is distressing that there are so many impossible derivations; if a Maya word means one thing, it hardly advances one's cause to say it means something totally different. There is little attempt to test a sound value against all appearances of the glyph in question.

Knorozov believes Maya writing to be a mixture of ideographic and phonetic; his pairings of sound with glyphic element are numerous. He has passed the point at which, if his readings are correct, the rate of decipherment should have accelerated astonishingly, for, as with a code, each new phonetic reading makes solution of the remainder easier. That did not happen with previous essays in phonetic decipherment from Brasseur de Bourbourg to Benjamin Whorf; it has not happened with Knorozov whose conquest of the problem was announced seven years ago. In each case there is a starting gush of unproven decipherments, but they do not swell to a river. Instead they peter out in a bog. For a similar rejection by a glyphic specialist of Knorozov's claims, see Barthel (1958).

In conclusion, the most promising path to decipherment is noted and its difficulties underlined.

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Saffron Walden, England
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RADIOCARBON DATING IN THE ARCTIC

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THE radiocarbon laboratory, operated by the Department of Physics and the University Museum at the University of Pennsylvania, is concentrating its analyses in four fields of archaeology: the Middle East, Middle America, South America, and the Arctic. It is the policy of the laboratory to publish radiocarbon dates only in groups from one specific field after checks and rechecks of related materials result in a certain measure of internal consistency (Ralph 1955: 149-51; Coon and Ralph 1955: 921-2). This is the first series of dates on Arctic materials to be published by the laboratory. It will be apparent that the series does not yet define a convincing cultural chronology for the American Arctic. Many of the materials are not wholly dependable, correlations between organic materials and cultural levels are in some cases uncertain, and we are lacking materials from many important sites and cultural levels. However, we hope that this series will give at least a tentative framework for Arctic dating. Also we hope that its publication will bring to the laboratory from many sources the materials we need to fill in and check the tentative outline presented here.*

The dates are listed in relation to cultural periods as defined in the Ipiutak study by Larsen and Rainey (1948) and are grouped by site and level in so far as possible. Many of the earlier analyses were done with the solid carbon method similar to that utilized at the University of Chicago laboratory (Libby 1955), but the more recent ones were done with the carbon dioxide gas counting technique. We consider the carbon dioxide analyses the more reliable; they are identified in the following list with an asterisk.

The error quoted for each count includes the statistical counting error for the individual run and the uncertainty in the reference points for the period of that measurement. The reference points are the "background" and "modern" counting rates. The background, unwanted counts which are not eliminated by shielding, is determined at least once a week by counting samples of anthracite coal, a source of carbon so old that it has no detectable C^{14}. The modern value is the reference at the other end of the time scale, the starting point upon which the age calculations are based. This calibration is more difficult than the background because the present-day value has been depleted by the combustion of fossil fuels over the last 100 or more years and, more recently, has been increased by the nuclear bomb tests. We therefore determine this value indirectly by measuring a series of samples of known age. At the high end of the scale, we use samples of wood 200 and more years old that have been dated by tree-ring analysis; in the middle 2500 year range, charcoal and wood from Gordion, Turkey, dated by parallels with Assyrian objects; and at the end of the archaeologically known range, Egyptian wood from tombs of pharaohs younger than 1800 B.C. The counting rates from these are then plotted on a graph and a curve with the C^{14} half-life (5568 ± 30 years; Libby 1955) slope drawn through them. Our modern value is the point where this curve intercepts the axis of zero age. Thus, it is based upon a series of archaeologically known samples, and the uncertain fluctuations of the present value are avoided.

In addition to the statistical counting errors, two other types may be considered — namely, "laboratory" and "physical." For the former, the samples counted by the solid carbon method were subject to possible contaminations from atomic and hydrogen bomb tests and from volatile C^{14} isotopes with which scientists in nearby buildings were experimenting. This is due to the fact that finely divided carbon is a very good absorber and that it was necessarily exposed to the atmosphere for brief intervals in the process of preparation, and also to the fact that this natural C^{14} has a much weaker radioactivity

* Minimum quantities required for dry samples in order of preference:

Material	*Grams*	
Charcoal	30	
Wood	40	(approximately a 2 inch cube)
Vegetable matter such as tubers, seeds, nuts and grains	40	(30 if charred)
Cloth, paper	40	
Hide	50	
Peat	60	
Organic matter mixed with gravel and earth	150	
Bones, charred only	300	
Ivory	50	
Antlers	100	

than these external ones. The C^{14} contamination could not be separated from the natural C^{14} which we were trying to measure, and these samples were discarded. The ones processed during periods of bomb tests were acid treated to remove the contamination and recounted, and when sample quantities were sufficient, duplicate portions were counted at different times. If any of these contaminations were introduced and not detected, erroneously young dates would be recorded. To avoid this drawback of the solid carbon method and also to increase the efficiency of natural C^{14} detection, we changed our equipment in 1956 to proportional counting of pure carbon dioxide gas. The sample can now be converted to CO_2 and purified in a closed glass train without exposure to atmospheric contamination. Another advantage is that the reaction, the making of CO_2, goes to completion so that there is no possibility of introducing isotopic fractionation, that is, of changing the ratio of C^{14} in a given quantity of carbon. The fact that uncontaminated solid carbon dates tend to be older than gas dates of the same material indicates that this source of error may be significant and possibly erratic depending upon the solid carbon reduction reaction. Also, the final CO_2 is pure and no correction is needed for impurities, such as ash and water which are an additional source of error in the solid carbon method. The efficiency is increased and as a result the statistical counting error is reduced because 80% of the C^{14} radiations are counted in contrast with a count of only 5% in the solid carbon method. The carbon dioxide dates are believed to be good with respect to laboratory difficulties, freedom from contamination, and so forth, with the possible exception of the first series counted, that of H. Michael (samples P-83, P-85, P-88, P-84, P-80, P-82, and P-110), as explained in the date list.

The physical states of the samples may have introduced other errors. Conditions for sample collection in the Arctic and the types of samples available are not ideal. The Denbigh samples, for example, were infested with modern or younger rootlets from alders and other vegetation which grew above the site. Bones, when heavily charred, are considered reliable. The Dorset dates were run on bones which were thoroughly charred. Most of the wood samples listed consisted of solid pieces which were well preserved and free of rootlets. Antlers, the materials for many of these dates, are questionable, although antlers are usually considered better than uncharred bones. Comparisons of dates from antlers and other organic substances are shown in Table 1.

Unfortunately, the materials for comparison were not ideal. The large difference between P-138 and P-192, in this young age range, may be erroneously large because of the possible contamination of the wood with "dead" paraffin. More importance may be credited to the difference found between P-175 on the one hand, and P-96, P-203 on the other, because younger rootlet infusion could cause only diminution of the dif-

TABLE 1. COMPARISON OF DATES FROM ANTLER AND OTHER ORGANIC MATERIALS.

Name	*Lab. No.*	*Material*	*Years B.P.*	*Difference*
Ipiutak, Pt. Hope	P- 98	antler	1619 ± 200	0
Ipiutak, Cape Krusenstern	P-225	charcoal with few rootlets	1651 ± 130	
Kachemak Bay III	P-138	antler	1369 ± 102	358 ± 75
Palugvik	P-192	wood with possible paraffin	1727 ± 105	
Choris Peninsula	P-175	antler	2244 ± 133	397 ± 127
	P- 96	disintegrated wood with rootlets	2635 ± 125	
	P-203	charcoal with few rootlets	2646 ± 117	
Igloolik	P-212	antler	2404 ± 137	506 ± 133
	P-213	ivory	2910 ± 129	
	P-208	antler	3560 ± 123	346 ± 128
	P-209	ivory	3906 ± 133	

ference. Ivory is more dense than antler and has a higher carbon content so that it would be expected to furnish a more reliable radiocarbon date. This brief list indicates that antler dates are erroneously young and that the discrepancy increases with age.

It will be noted that several significant dates determined by the gas and solid carbon methods in this laboratory do not correspond with Libby's dates produced from the solid carbon method utilizing materials from the same sites. The Denbigh discrepancies, samples P-13 and P-102, and the corresponding Chicago dates (C-563, C-793) could be attributed to the lack of homogeneity or rootlet contamination of the materials. However, the Hillside site samples P-70 and P-94 were suitable wooden objects, and we can find no explanation for the large difference in age between our dates and that from Chicago (C-505). In some cases the agreement with other laboratories is good. The few samples from the same sites and levels dated in this laboratory by both solid carbon and gas methods show good correlation, as evidenced by P-70 compared with P-94 and P-71 compared with P-93. However, we emphasize again that the CO_2 dates are more reliable, especially when a chronological series is measured so that the odd misfit due to either laboratory or physical error can be detected.

NEO-ESKIMO SITES AND LEVELS

Ekseavik site, Kobuk River, Alaska. Samples collected by J. L. Giddings. Giddings (1952) defines five periods in Arctic Woodland culture along the Kobuk River. The following dates are for the Ekseavik period on the middle river dated by the tree-ring method at about A.D. 1400. This is next to the oldest period represented in his excavations.

P-16 Spruce wood. House 11, No. 42. Dated by tree-ring analysis, A.D. 1084 to 1387. The average of two runs is:
780 ± 150 B.P. A.D. 1177

P-29 Spruce wood. House 11, No. 33. Dated by tree-ring analysis, A.D. 1220 to 1365.
720 ± 200 B.P. A.D. 1237

P-31 Wood. House 11, No. 1. Dated by tree-ring analysis, A.D. 1366. Sample consisted of 155 rings.
820 ± 220 B.P. A.D. 1137

Ievoghiyoq site, Gambell, St. Lawrence Island, Alaska. Samples collected by H. B. Collins, 1930 excavations (Collins 1937b). Ievoghiyoq is representative of the Punuk period.

P-69 Punuk Period. U. S. National Museum Cat. No. 354968. Wooden dish bottom, Cut 2, Section 8, depth 52 inches (base).
1070 ± 210 B.P. A.D. 887

P-92 Punuk Period. U. S. National Museum Cat. No. 354971. Wooden object, Cut 2, Section 8, depth 52 inches (base).
910 ± 145 B.P.* A.D. 1047

Miyowagh site, Gambell, St. Lawrence Island, Alaska. Sample collected by H. Michael in 1952.

P-83 Early Punuk Period. Wooden shaft from 1.35 meters below surface, that is, 2.5 meters below house rim.
1013 ± 111 B.P.* A.D. 944

Utkiavik site, Point Barrow, Alaska. Samples collected by W. B. Van Valin, 1917-19.

P-73 Birnirk Period. University Museum Cat. No. 29-90-608. Handle for something? Part of boat? Light-weight, coarse-grained wood, oval-shaped cylinder, 20 to 30 tree-rings. Broken end gives impression of having been hafted in something. From House 4 (box 15). Not on Van Valin's list.

P-73	1620 ± 300 B.P.	A.D. 337
P-73a (another portion)	1320 ± 220 B.P.	A.D. 637
Average	1430 ± 190 B.P.	A.D. 527

P-97 Birnirk Period. University Museum Cat. No. 29-90-293. Wooden meat tray from House 3, Skeleton 12.
1146 ± 95 B.P.* A.D. 811

Anderson Point site, Arctic Sea coast between Barter and Flaxman islands. Excavated by Giddings and Ricciardelli in 1952. Material seems roughly equivalent to Birnirk culture, Point Barrow. Spruce wood.

P-55	1160 ± 240 B.P.	A.D. 797
P-55a	1090 ± 310 B.P.	A.D. 867
Average	1130 ± 200 B.P.	A.D. 827

Kurigitavik site, Cape Prince of Wales, Alaska. Samples collected by H. B. Collins. In a personal letter Collins defines the material as follows:

A Thule-Punuk period site, excavated 1936. A Birnirk type harpoon head was found in Cut 3 at depth of 86 inches, and Birnirk type pottery occurs in this and other cuts throughout the mound from about the middle to

bottom. Thule-Punuk harpoon heads exhibit features suggestive of Birnirk, though one referred to above, from depth of 86 inches, was the only typical Birnirk head found at the site.

The site is described in detail by Collins (1937a, 1940).

The samples that comprise this series (P-68, P-67, P-65, and P-63) were among the last ones dated by the solid carbon method. The counting runs were made during a period of fall-out and were not as reliable as desired.

P-68 Thule-Punuk Period. (Sample 4) Piece of wooden dish bottom and 17 small pieces of wooden shafts. Cut 2, Section 4, depth 20 inches.
1350 ± 360 B.P. A.D. 607

P-67 Thule-Punuk Period. (Sample 3) Two pieces of a single wooden dish bottom. Cut 6, Section 4, depth 29 inches. Typical Thule-Punuk harpoon heads and other artifacts occur at this level.
1230 ± 240 B.P. A.D. 727

P-65 Birnirk Period. (Sample 1) Nine small pieces of wooden shafts. Cut 3, Sections 20 and 21, depth 88 and 90 inches (base). A Birnirk harpoon head was found in this cut at a depth of 86 inches.
1320 ± 230 B.P. A.D. 637

P-63 Birnirk Period. (Sample 5) Wooden dish bottom. Cut A, Section 26, depth 101 inches. Specimen is from near the base (upper part of slope) of a large steeply sloping midden on the high beach just south of Wales village. A Birnirk harpoon head was found in another nearby cut at about this level. Surface of midden contains recent material.
1480 ± 240 B.P. A.D. 477

Yukon Island site, Cook Inlet, Alaska. Samples collected by Frederica de Laguna in 1932. De Laguna (1934) defines five periods at this site which are described as Kachemak Bay I, II, III, sub-III, and IV. The following date is for period III only. Dates for Kachemak Bay I will be found with the Paleo-Eskimo series.

P-138 Kachemak Bay III Period. Five pieces of caribou antler from the period III level of the Yukon Island site.
1369 ± 102 B.P.* A.D. 589

Palugvik site, Hawkins Island, Prince William Sound, Alaska. Sample collected by Frederica de Laguna. This is a large midden, located on the western spit of Hawkins Island, excavated in 1938. The midden consists of four layers, the bottom layer (No. 1) beginning in Kachemak Bay III or sub-III period while the top layer (No. 4) indicates that the site was abandoned before European contact. The specimens submitted for radiocarbon analysis are described by de Laguna (1956). The radiocarbon dates and analysis of archaeological material place this culture in the Neo-Eskimo horizon.

P-174 and P-192 House post, wood, University Museum Cat. No. 33-37-476. Large post with 105 rings, coated with paraffin which may not have penetrated.

P-174 Piece from outer part of post. Kachemak Bay III 1753 ± 105 B.P.* A.D. 205

P-192 Piece from core of post. Average age of 83 years has been subtracted from the radiocarbon age. Kachemak Bay III 1727 ± 105 B.P.* A.D. 231

Note: The suspicion of paraffin contamination was prompted by the date of another sample, a wooden shovel blade (P-173, 2265 ± 112 B.P.*), which should have been contemporaneous with P-174. The core of the house post (P-192) was therefore counted. The fact that the dates of P-192 and P-174 do agree indicates that this sample did not have serious paraffin contamination.

Hillside site, Gambell, St. Lawrence Island, Alaska. Samples collected by H. B. Collins, 1930 excavations. This series of dates from the Hillside site is critical in determining the relative ages of the Okvik and Old Bering Sea periods. Collins originally described Okvik material as "Old Bering Sea Style I" and it was not until some years later that Rainey (1941) and Rudenko (1947) established Okvik as a distinct period. Everyone writing on Eskimo archaeology during the past 20 years has assumed that Okvik precedes rather than follows Old Bering Sea. These dates, if correct, reverse the order. Collins' statement (taken from letter from H. B. Collins to J. L. Giddings, May 10, 1955) on these samples is as follows:

Ievoghiyoq is representative of the Punuk Period, Miyowagh of Old Bering Sea, and the Hillside site of OBS [Old Bering Sea] style 2 and style 1. It will be interesting to see what age difference there may be between the ma-

terial from House No. 1 and House No. 2, Hillside site. House No. 1 contained typical OBS style 2 art, with a few style 1 pieces beneath the floor stones. House No. 2 contained only OBS style 1. It should be noted that style 1 as I originally described it on the basis of the Hillside objects did not include any examples of the most typical Okvik decoration such as you [Giddings] got at your Gambell house and as occurred on several Little Diomede pieces which I described (Text fig. 8, p. 53 and Pl. 14, [Collins 1937b]). Thus, my House No. 2 might be somewhat older, or later, than your house and the Okvik site. On the other hand the absence of the more typical Okvik art in my two houses might be accidental, considering the few specimens obtained; also, one of my objects (Text fig. 5, p. 44 and Pl. 12, fig. 11) appears identical in form and decoration to Rainey's [1941] Pl. 36, fig. 7 from the Okvik site.

One analysis by Libby (C-505), with the solid carbon method, of spruce wood from an Okvik period house at this site, excavated by Giddings in 1939, gave a date of 307±230 B.C.

P-70 Okvik Period. (Old Bering Sea style 1) U. S. National Museum Cat. No. 352547. Wooden object, Hillside site, House 2, below floor stones.
1420±230 B.P. A.D. 537

P-94 Okvik Period. (Old Bering Sea style 1) U. S. National Museum Cat. No. 352558. Wooden object, Hillside site, House 2, below floor stones. Two counting runs of the same sample gave ages of A.D. 500±113* and A.D. 557±125*.
Average 1429±121 B.P.* A.D. 528

P-95 Old Bering Sea Period. (Old Bering Sea style 2) U. S. National Museum Cat. No. 352646. Wooden objects, Hillside site, House 1. Two counting runs of the same sample gave ages of A.D. 315±110* and A.D. 317±101*.
Average 1641±106 B.P.* A.D. 316

Miyowagh site, Gambell, St. Lawrence Island, Alaska. Samples collected by H. B. Collins, 1930 excavations.

P-71 Old Bering Sea Period. U. S. National Museum Cat. Nos. 353754 and 353769. Wooden objects, fire drills, Cut 7, levels 8 and 9, depth 46-51 inches.
1630±230 B.P. A.D. 327

P-93 Old Bering Sea Period. U. S. National Museum Cat. No. 353744. Wooden objects, Cut 7, Section 7, depth 37 inches.
1700±150 B.P.* A.D. 257

Miyowagh site, Gambell, St. Lawrence Island, Alaska. H. Michael collected the following series of samples at the Miyowagh site in 1952. The organic materials were labeled on the basis of their association with artifacts typical of a period. In most cases examined here, there was also the reinforcing factor of depth below undisturbed surface.

P-85 Late Old Bering Sea Period. Wood from 0.8-1.0 meter level in association with ivory point (harpoon).
1002±107 B.P.* A.D. 955

P-88 Old Bering Sea or Early Punuk Period. Outer piece of large log found lying on flagstone floor of structure. Collins' House 3 entrance.
1231±108 B.P.* A.D. 726

P-84 Old Bering Sea Period. Roof beam of House 4, 1.4 to 1.6 meter level, in association with whaling harpoon head.
1296±108 B.P.* A.D. 661

P-80 Old Bering Sea Period. Wood from Bag 12, associated with artifacts in Bag 11, 0.8 meter above P-88.
1398±116 B.P.* A.D. 559

P-110 Old Bering Sea Period. Walrus hide covering entrance of passage to House 4, extending from 0.8 to 1.75 meters; that is, to floor of entrance passage.
1380±118 B.P.* A.D. 577

These six samples were counted early in 1957 and were the first unknown ones processed with our proportional CO_2 equipment. The results, therefore, are less reliable than the dates obtained later. Counting fluctuations caused by cosmic showers and other external events may not have been detected.

PALEO-ESKIMO SITES AND LEVELS

Ipiutak site, Point Hope, Alaska. Samples collected by F. Rainey. This is the type site for the Ipiutak stage of what Larsen and Rainey described as the Paleo-Eskimo horizon in the Arctic. Libby's original dates (C-260, C-266) for this site, with the solid carbon method, were about A.D. 1000. The analyses by Libby were of wooden objects found in the site. The following are of carbou antler arrowheads, Type I, one of the most typical artifacts at Ipiutak. Fourteen arrowheads and fragments weighing 46 grams were burned for four different counting runs. Various equipment difficulties occurred while counting

these samples. The average, A.D. 339±210, agrees with the last two and is probably correct. The four runs are:

P-98	Ipiutak Period	1763±200 B.P.*	A.D. 194
		1451±200 B.P.*	A.D. 506
		1660±240 B.P.*	A.D. 297
		1600±200 B.P.*	A.D. 357
	Average	1619±210 B.P.*	A.D. 339

Cape Krusenstern site, northwest Alaska. Sample collected by J. L. Giddings in 1958. This extensive site, located and partially excavated by Giddings in the summer of 1958, contains remains representing several different cultural periods. At the present time we have been able to include only one analysis from the Ipiutak period at this site. This was a specimen of charcoal which was damp and infested with fine rootlets. All visible rootlets were removed before processing. Sample from House 1.

P-225 Ipiutak Period 1651±130 B.P.* A.D. 307

Iyatayet site, Cape Denbigh, Norton Bay, Alaska. Samples collected by J. L. Giddings. There are three cultural levels at Iyatayet, an upper Neo-Eskimo level, a middle Paleo-Eskimo (Norton culture) level, and a separated lower level defined as the Denbigh Flint complex. This series of dates is for the middle, or Paleo-Eskimo level. Libby's laboratory at the University of Chicago, using the solid carbon method, produced two dates for this level: A.D. 497±200 (C-506) and 59±250 B.C. (C-563).

P-13 Paleo-Eskimo Period (Norton culture). Charcoal from baseline timbers of west wall. A new portion of the same material as that used for Libby's 59 B.C. date (C-563). Three solid carbon runs are:

	2420±270 B.P.	463 B.C.
	2530±330 B.P.	573 B.C.
	2130±260 B.P.	173 B.C.
Average	2360±170 B.P.	403 B.C.

One CO_2 determination is:

2213±110 B.P.* 255 B.C.

Choris site, Choris Peninsula, Kotzebue, Alaska. Samples collected by J. L. Giddings. This site has not been published in detail, but in a preliminary report (Giddings 1957), the excavator states that "the Choris artifacts are much closer typologically to Norton forms than to those of the Denbigh Flint Complex." Hence we have included the radiocarbon dates here with the Paleo-Eskimo horizon dates rather than with those of the Ancient Arctic cultures horizon.

P-96 Oval House 1. Partially disintegrated base log, heavily infused with rootlets. Collected in 1956.

2635±125 B.P.* 677 B.C.

P-175 Oval House 1. Worked fragments of antler from floor deposit, few rootlets. Collected in 1956.

2244±133 B.P.* 286 B.C.

P-203 House 2. Charcoal from below roof level at north end of house pit. Visible rootlet contamination removed before processing. Collected in 1958.

2646±117 B.P.* 688 B.C.

Native Point site (T 1), south coast of Southampton Island, Hudson's Bay, Canada. Collected by H. B. Collins, 1954 and 1955. This is an early Dorset period site (Collins 1956). It has become clear that Dorset in the eastern Arctic extends over a very considerable time period.

P-62 Dorset Period. The sample consisted of charred bones taken from Test Pit 6 on the northeast end of T 1 plateau, on a gravel ridge about 50 yards from Collins' Dorset midden site on Southampton Island. Collins comments (in a letter to J. L. Giddings, April 15, 1955): "This was a barren ridge with no grass cover such as was present over the midden. We dug it to see if there was a subsurface occupation level, which was suggested by the presence of Dorset stone implements on the surface. There was such a level, or rather a hearth, at 14 in. deep, containing large quantities of burned mammal bones, blackened earth and gravel, and many bird bones. A number of the bird bones with the ends broken off had old grass roots inside, showing that there had once been a growth of vegetation over the site. There were so few artifacts that it was doubtful just how this cut should be placed, chronologically, in relation to the Dorset midden proper. I have no doubt that it is Dorset, though possibly of different age than the site proper." Sample was collected in 1954.

2060±200 B.P. 103 B.C.

P-74 Dorset Period. (Sample 1) Burned bone, soil and a few pieces of char-

coal from hearth area in Test Pit 8, T 1, an early Dorset or proto-Dorset site at Native Point, south coast of Southampton Island, Hudson's Bay; depth 12 inches (base). Collins comments (same letter to Giddings): "The site is not frozen and grass roots penetrate to the bottom of the culture layer at all places. However, there is no heavy penetration of grass roots despite the shallow depth of the site. The surface vegetation is sparse and dry, consisting of a thin mat of dryas, saxifrages, mosses, lichens, and low grass."

2183 ± 122 B.P.* 226 B.C.

P-75 Dorset Period. (Sample 2) Burned bone from T 1, Trench A, Square 1, level 2, depth 6 inches. Collins states: "This excavation is 275 yards from Test Pit 8. The soil here differs from that around Test Pit 8 in being very sandy with relatively little gravel. It is also far more prolific in artifacts and certain cultural differences were also noted. There might be an age difference between this part of the site and Test Pit 8."

2508 ± 130 B.P.* 551 B.C.

P-76 Dorset Period. (Sample 2A) Burned bone from T 1, Trench A, Square 5, levels 2 and 3, depth 6 to 10 inches.

2632 ± 128 B.P.* 675 B.C.

P-77 Dorset Period. (Samples 3 and 4) Sample 3: burned bone from T 3, Square 1, level 2, depth 8 inches. Collins states: "The T 3 site is at a 30-foot lower elevation than T 1, being on a 40-foot high old beach ridge at the base of the T 1 plateau which is 70 feet high. The majority of the T 1 implements were also found at T 3, but there were quantitative differences and also a few types at T 3 which suggest a later age."
Sample 4: burned bone, T 3, Square 9, level 2, depth 8 inches. No cultural or other differences. These two were combined to provide a sufficient quantity for a counter filling. Two separate counts of this combination gave ages of 225 ± 120 B.C.* and 243 ± 120 B.C.*

Average 2191 ± 120 B.P.* 234 B.C.

Igloolik site, Northwest Territory, Canada. Samples collected by Jørgen Meldgaard in 1954 and 1957. This very extensive site, excavated by Meldgaard for the Danish National Museum and the University Museum, Philadelphia, has not been published in detail but we know from preliminary reports that there are represented here two distinct cultures, termed Sarqaq and Dorset, with several stages in each period. We have included the Dorset period dates in this section and the Sarqaq period dates in the section under Ancient Arctic cultures.

A letter from Meldgaard dated May 8, 1958, states: "Of the Dorset Culture I have made a preliminary division into 5 periods (I-V) based on the 1954 material, but after the 1957 excavations it is clear that there is only a very little difference in time between the latest Sarqaq and Dorset I." All samples were collected from house ruins placed upon old raised gravel beaches. The culture stage is recognized from a large number of artifacts and the sequence is confirmed by the height above present sea level.

P-212 Dorset Period, stage I. (Sample 6) Locality, Alarnek; height above sea level, 22 meters; material, antler.

2404 ± 137 B.P.* 446 B.C.

P-213 Dorset Period, stage I. (Sample 7) Locality, Alarnek; height above sea level, 22 meters; material, ivory.

2910 ± 129 B.P.* 952 B.C.

Yukon Island site, Cook Inlet, Alaska. Samples collected by Frederica de Laguna in 1932. There were five cultural levels at this site described as Kachemak Bay I, II, III, sub-III, and IV. Level III has been included with the Neo-Eskimo sites and levels.

P-139 Kachemak Bay I Period. Eight pieces of caribou antler from the earliest level at the site were combined and burned for the analysis.

2706 ± 118 B.P.* 748 B.C.

ANCIENT ARCTIC CULTURES

Engigstciak site, Firth River, Yukon Territory, Canada. Sample collected by Richard S. MacNeish in 1958. At present we have been able to run only one analysis of material from this site. A letter from MacNeish dated October 6, 1958, describes the material as follows:

Specimen No. 4 is from the Engigstciak Site, Pit 32, and underneath ceramics of Cordmarked and Dentate pottery. Typologically it seems to be an early kind of Cape Denbigh. . . . It would be a nice check on the various Carbon 14 dates on Denbigh from Alaska as well as the Cape Denbigh-like material from Igloolik and Green-

land. Dates on specimens such as these should tell us much about the time and speed of the Arctic Small-tool migration.

P-228 Antler from pit 32, levels 3-4, 1.7 feet; N. VK-1, S135W25, Early Mountain phase.
3208 ± 156 B.P.* 1250 B.C.

Igloolik site, Northwest Territory, Canada. Samples collected by Jørgen Meldgaard in 1954 and 1957. As observed above, this site contains material representing two distinct cultures termed Sarqaq and Dorset with several stages in each period. The Dorset dates were included above in the Paleo-Eskimo section. The dates given here are for the early and late periods of the Sarqaq culture. The site has not been published in detail but in a letter dated May 8, 1958, Meldgaard states:

> The early Sarqaq-like material found in the Igloolik area probably represents the earliest traces of a culture, which we can identify as an "Eskimo culture." The flint artifacts point towards Denbigh Flint Complex (burins and microblades) and Denbigh Middle layers (lanceolate blades), but the rich bone material preserved reveals typical toggle harpoon heads (proto-types of Birnirk and early Thule). Datings of the initial stage and of the final stage (samples no. 1 or 2 [3], and no. 5) would be of special interest.

One analysis of this material was made by the Copenhagen laboratory with the solid carbon method (K-505). This was a sample from the 51-meter level, Early Sarqaq, and is identical with our P-208 below. The Copenhagen date is 3700 ± 300 years B.P., 1742 B.C.

Larsen and Meldgaard (1958) define Sarqaq as a Paleo-Eskimo culture. We have taken the liberty of including it here with the Ancient Arctic cultures because of its age and its connections with the Denbigh Flint complex.

All samples were collected from house ruins found in raised gravel beaches. The cultural stage was determined by a large number of artifacts and the sequence is confirmed by the height above sea level.

P-207 Sarqaq Period, Early stage. (Sample 1) Locality, Kaleruserk; height above sea level, 52 meters; material, ivory.
3958 ± 168 B.P.* 2008 B.C.

P-208 Sarqaq Period, Early stage. (Sample 2) Locality, Kaleruserk; height above sea level, 51 meters; material, antler.
3560 ± 123 B.P.* 1602 B.C.

P-209 Sarqaq Period, Early stage. (Sample 3) Locality, Kaleruserk; height above sea level, 51 meters; material, ivory.
3906 ± 133 B.P.* 1948 B.C.

P-210 Sarqaq Period, Early stage. (Sample 4) Locality, Kapuivik; height above sea level, 44 meters; material, antler.
2898 ± 136 B.P.* 940 B.C.

P-211 Sarqaq Period, Late stage. (Sample 5) Locality, Kapuivik; height above sea level, 24 meters; material, antler.
2354 ± 135 B.P.* 396 B.C.

Iyatayet site, Cape Denbigh, Norton Bay, Alaska. The material which Giddings has defined as the Denbigh Flint complex (Giddings 1949) was originally found in a distinct stratum below the Paleo-Eskimo levels at the Iyatayet site. Charcoal samples from the very thin layer of Denbigh flint material are contaminated with roots of later date and cannot be successfully separated. Hence we know that the Chicago, U.S.G.S., and Pennsylvania dates (C-792, C-793, W-298, P-105, and P-102) for this level are inaccurate. They are more recent than the actual age of the cultural material. The U.S.G.S. date (W-298; Rubin and Suess 1956) which was run by the gas method is 2013 ± 600 B.C.* David Hopkins of the U.S.G.S., who made a study of this site, believes that geological, paleobotanical, and radiocarbon evidence all point to an age of more than 5000 and less than 10,000 years (Giddings 1955). The most reliable dates we have are for the peat layer which lies below the Paleo-Eskimo level and above the Denbigh Flint material.

P-104 Second peat above Denbigh Flint complex, Section IYZ-5B. Sample consisted of peat and earth. The three counting runs are:
3240 ± 280 B.P. 1283 B.C.
2730 ± 300 B.P. 773 B.C.
3030 ± 280 B.P. 1073 B.C.
Average 3000 ± 170 B.P. 1043 B.C.

P-108 Peaty layer next above Denbigh Flint complex, Section IYZ-5A. Sample consisted of dry peat and earth. The two runs are:
2880 ± 280 B.P. 923 B.C.
3280 ± 300 B.P. 1323 B.C.
Average 3080 ± 210 B.P. 1123 B.C.

P-105 Soil above Denbigh Flint complex pebbles, but below peaty layer where peaty layer was covered with sterile sandy layer, Section IYZ-5B. Jar No. 1 contained 300 grams damp dirt

	with 1.8% carbon; Jar No. 2, 187 grams dirt with 2.4% carbon. Jars were combined to comprise sample P-105.		
		4040 ± 280 B.P.	2083 B.C.
P-103	Charcoal from two fireplaces, Section IYZ-5D. Sample consisted of lumps of charcoal and charred twigs. The two runs are:		
		3430 ± 280 B.P.	1473 B.C.
		3520 ± 290 B.P.	1563 B.C.
	Average	3480 ± 200 B.P.	1523 B.C.
P-102	Fireplace from Section IYR. Sample consisted of bits of charcoal, earth, and a few very small roots. The Chicago date (C-793) for this section was 2707 ± 220 B.C. The two runs are:		
		3290 ± 290 B.P.	1333 B.C.
		3320 ± 280 B.P.	1363 B.C.
	Average	3310 ± 200 B.P.	1353 B.C.

SUMMARY

We wish to repeat, and to emphasize, that there are many doubtful dates in the various series listed here. We know that many more analyses will be necessary to produce a reasonably sound chronology in the American Arctic and we shall carry on analysis in this field for some time to come. We urge that adequate samples of organic material which have a precise association with recognizable cultural levels be sent to the laboratory by those working in the Arctic field. For example, we are in need of organic materials associated with the Denbigh Flint complex, the Old Bering Sea period, the Okvik period (particularly the type sites on Punuk Island and at East Cape, Siberia), and from all of the sites which we have designated as of the Paleo-Eskimo period.

However, we wish to point out that in general the Pennsylvania dates obtained with the CO_2 method are more reasonable than the dates originally obtained with the solid carbon method. For example, solid carbon analysis for the Okvik and Ipiutak periods separated them in time by some 1200 years. All archaeological evidence indicates that these two periods must be more or less contemporary. The more reliable CO_2 dates listed here are therefore more consistent with the archaeological evidence. Moreover, the time relation between the Neo-Eskimo and Paleo-Eskimo horizons assumed from the nature of the cultural material, is also borne out by the CO_2 analysis. Hence we believe that a certain measure of internal consistency is beginning to emerge in radiocarbon dating for the Arctic.

For the time being, utilizing only the CO_2 dates from the sites where we are relatively certain of good correlations between organic materials and cultural periods, we can summarize a tentative cultural chronology as follows:

NEO-ESKIMO HORIZON	
Punuk Period	A.D. 1000
Birnirk Period	A.D. 800
Kachemak Bay III Period	A.D. 600
Okvik Period	A.D. 500
Old Bering Sea Period	A.D. 300
PALEO-ESKIMO HORIZON	
Ipiutak Period	A.D. 300
Norton Period	300 B.C.
Dorset Period	200 to 700 B.C.
Kachemak Bay I Period	700 B.C.
Choris Period	700 B.C.
ANCIENT ARCTIC HORIZON	
Firth River (Early Mountain Phase)	1300 B.C.
Sarqaq	400 to 2000 B.C.
Denbigh Flint Complex	Earlier than 2000 B.C.

This chronology must be qualified as follows. The summary dates given are simply those determined from a few samples from specific sites and levels. They do not give any indication of how long a certain period may have survived. For example, Giddings believes that his Norton period endured for several centuries at the type site. For the same reason the Okvik period may eventually prove to be older than the Old Bering Sea period (rather than younger as these dates indicate) when we have analyzed material from other sites. Also, as an example, we can be sure from archaeological evidence that the Dorset period survived much later than 200 B.C. Speculations on length of periods, on overlaps, and on interrelations are beyond the scope of this paper. There are also certain technical qualifications. Analysis of antler apparently gives younger dates than analysis of charcoal from the same level; some samples are contaminated and we are not sure that all contamination has been removed; analysis of a single sample from one site or level is not sufficient to give an assured date.

However, we believe that this radiocarbon study has gone far enough so that we can state with some assurance that men had already occupied the Arctic Coast of North America all the way from Alaska to Greenland some time before 2000 B.C., and that there are at least three major

time-horizons in Arctic culture. Just when the Eskimos (as defined in specific physical, linguistic, and cultural terms) arrived on the scene remains an open question.

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A STATISTICAL TECHNIQUE FOR CLASSIFYING HUMAN SKELETAL REMAINS

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A RECURRING question posed to the physical anthropologist by his archaeological associates concerns the problem of properly classifying new skeletal finds within the framework of a known local prehistory. An analysis may result which is initially purely quantitative. However, problems demanding interpretation often develop. For example, when the physical characteristics of prehistoric populations have been metrically described, their industrial accomplishments outlined, and their place in time fairly well established, the problem of spatial distribution becomes a primary interest. The discovery of skeletal material, peripheral to the known area of occupation, must be explained either as an addition to the known biological pattern or as representing a foreign element.

Current methods for differentiating skeletal populations consist of morphological observations and detailed mensuration. Final judgments of group affiliation may result from a metrical trait analysis based on prescribed types (Neumann 1952) or from the comparison of mean measurements with subsequent testing for statistical significance. In cases where a new discovery is made up of many specimens, a metrical comparison may be definitive. But, where the new find consists of the skeletal remains of one individual, or a household group, physical association with the proper parent population becomes much more difficult. Although cultural assemblages may give clues to possible identification, the investigator, in most instances, must make a decision based on his own experience and knowledge. This kind of subjective methodology may or may not be successful but, as Thieme (1957: 79) points out, "there is no explicit statement of probability that is inherent in the method. We are forced to evaluate the expert and cannot evaluate his methods except to note his experience."

In recent years, a number of attempts have been made to render more objective the standard methods of skeletal comparison. Better documented samples and more reliable statistical procedures have led to an increased knowledge of the real limits of population variability and, at the same time, have added greater precision to technical improvements. Thus, Thieme's use of the discriminant function for determining the sex of unknown remains is a successful attempt to lend more objectivity to present methods of sex identification.

The use of multiple measurements to designate the relationships of small samples of individuals to one or more probable parent populations is not new. It has been demonstrated in several fields; for example, in botany, the separation of species of iris (Fisher 1936); in agronomy, the differentiation of soil types (Cox and Martin 1937); in genetics, the selection of genetically desirable types of plants (Smith 1936) or poultry (Panse 1946); in physical anthropology, the investigation of changes through time in the characteristics of Egyptian skulls (Barnard 1955), the discrimination of species by dentition (Bronowski and Long 1952), the determination of the sex of certain human bones (Pons 1955), and the sexing of Negro skeletons (Thieme 1957; Thieme and Schull 1957). In each case equations were calculated that determined proper classification with a high degree of success. However, application of the discriminant function to designate genetic relationships among human skeletal populations has yet to be thoroughly investigated. Although the ideal basis for differentiating skeletal populations would be genetic, our limited knowledge of the genetics of individual characteristics leaves us only the phenotypic with which to work. Thus, the discriminant function can only be used to differentiate between selected samples on a phenotypic basis. The genetic interpretation of the demonstrated differences must remain a problem for the future.

In this paper we discuss the calculation of a discriminant function that will best indicate the metrical relationships of two prehistoric skeletal populations from California. In this discussion we have recognized the importance of assigning isolated skeletal remains to their proper breeding groups.

Material and Methods

For our purposes, the two samples had to be archaeologically documented, come from approximately the same geographic area, be roughly comparable in size, and similar in chronological time span. Thus, we chose two prehistoric Indian populations that, with few exceptions, best fit these qualifications: *a*, a series from the vicinity

of Sacramento in central California (Newman 1957), consisting of 138 adult males ranging in age from 18 to 50 years; *b*, a series from the vicinity of Santa Barbara in southern California, including the neighboring islands of San Miguel, Santa Rosa, and Santa Cruz (McKern 1955), which is made up of 144 adult males ranging in age from 18 to 50 years. For both studies, the original data sheets were accessible to the present authors. Methods for selecting and measuring the two series were basically similar. Each sample represents a chronological span from early to late which is established on archaeological evidence, including radiocarbon dates for the cultural horizons of central California. As regards the genetic background of the material, there is no archaeological evidence of complete replacement by foreign populations from one occupation level to another. However, there is evidence of cultural change which has led to speculations of intermittent contact with outside peoples (Olson 1930; Newman 1957; McKern 1955). These contacts may or may not have affected the breeding structure, although from tests for variability, both Newman and McKern demonstrate fairly homogeneous populations with little morphological change over the stated time span.

From the total number of measurements taken on the two California samples, we use six for discriminant analysis. Our selection was limited primarily by two factors: *a*, measurements found in one sample were not available for the other, and *b*, some combinations resulted in samples too small for adequate statistical calculation. The following measurements gave the best results for our purposes: glabello-occipital length, auricular height, maximum bizygomatic diameter, maximum femoral length, femoral midshaft circumference, femoral subtrochanteric diameter (a-p).

The calculations for the discriminant function follow methods given by Johnson (1949). Additional testing of resulting data was carried out as suggested by Kendall (1948), Rao (1952), and Goulden (1952).

Results

Table 1 presents the comparative statistical values of the cranial measurements utilized in the present analysis: glabello-occipital length (X_1), auricular height (X_2), and maximum bizygomatic diameter (X_3). Figure 1 shows percent-

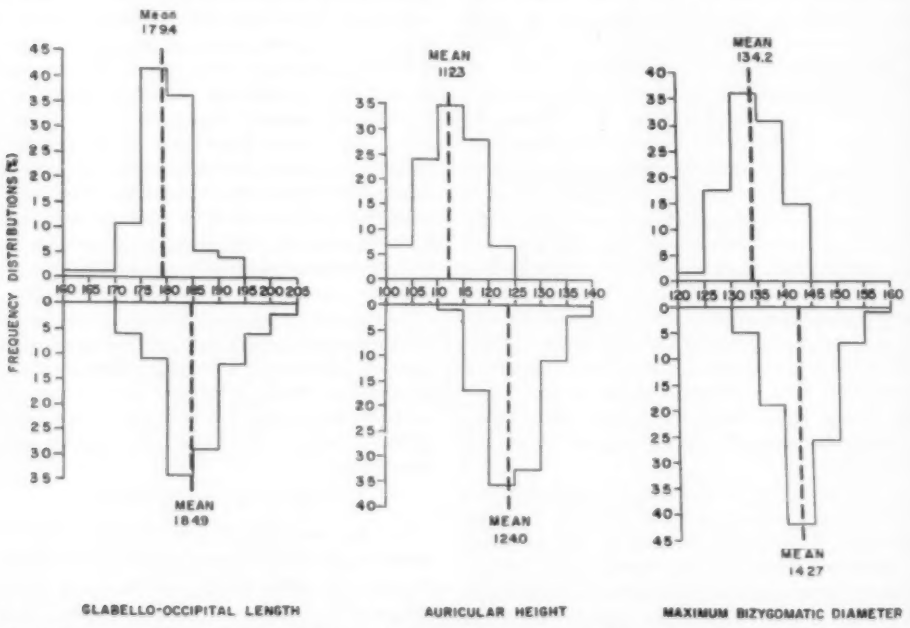

Fig. 1. Comparative frequency distributions of the three cranial measurements used in discriminatory analysis of two Californian skeletal populations. The series from southern California (N = 75) is above the horizontal scale of millimeter measurements; the central Californian series (N = 100) is below.

Table 1. Comparative Statistical Values of Cranial Measurements (in millimeters)

Measurement	Number	Group	Mean	Standard Deviation	"t"
Glabello-occipital length	75	Southern California	179.41	5.09	6.13*
	100	Central California	184.89	6.36	
Auricular height	75	Southern California	112.32	4.67	16.20*
	100	Central California	123.97	4.73	
Maximum bizygomatic diameter	75	Southern California	134.16	4.91	11.52*
	100	Central California	142.74	4.85	

* Significant at greater than the 1% level (2.61).

age frequency distributions in histogram form of these measurements for each of the samples. As will be seen, the data in Table 1 show that means of each of the three measurements differ significantly between groups, even though the graphs of Figure 1 show considerable overlap in each case. However, a linear combination of all three can be derived by discriminatory analysis which reduces the amount of overlap to a minimum. The resulting linear discriminant equation for determining index scores from the cranial data is given below. For facility in further calculations, the coefficients were all divided by the smallest of the three. Thus, the coefficient for glabello-occipital length becomes equal to minus 1.000, since it has negative power in the function. Using the equation,

$$U = -X_1 + 3.6383\,X_2 + 1.5373\,X_3,$$

with the means for each of the two groups in turn, and averaging the results, we get a "critical index value" (Freeman and Merriam 1956) of 460.53. Index scores for each specimen of both samples are calculated by substituting the respective measurements in the discriminating equation. These values are then tabulated and set up in a percentage frequency distribution (Fig. 2) with the combined sample equalling 100%.

With the exception of six of the 75 cases, the southern California scores fall below this "critical" value. On the other hand, all but nine of the 100 cases from central California fall above 460.53. Thus, only 8.6% of the total 175 cases have been misclassified by this technique. It should be noted that the shaded area in Figure 2 does not cover the whole bar between 460 and 470 in the southern California portion of the chart. This indicates that three of the cases in this category are higher than the critical value, while one case falls below. However, in the central California section all of the cases are higher than the dividing point. This same principle is used in the other figures depicting total scores of the two groups.

The analysis of variance done in the course of the discriminant function shows that the two populations differ very significantly ($F=102.33$). Carrying the analysis a step further, standard errors of the lambda coefficients were calculated (Kendall 1948). Since each coefficient exceeds twice its standard error, we can state that each measurement contributes significantly to the effectiveness of the discriminant function. However, discriminatory analyses were carried out, omitting each variable in turn, to show how each might affect the over-all results. Table 2 lists the percentage of cases that would have been misclassified by this method and indicates that auricular height is by far the most important of the three cranial measurements in the discriminant function, since its absence from the

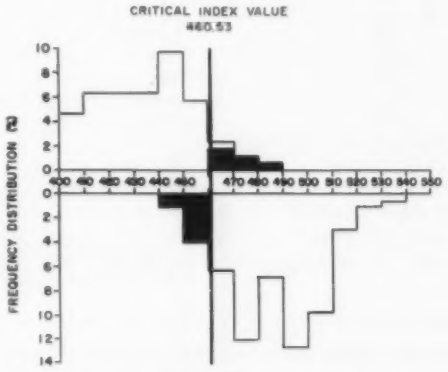

Fig. 2. Distribution of index scores for the three cranial measurements. The southern Californian series (N = 75 or 42.9%) is above; the central Californian series (N = 100 or 57.1%) is below. The shaded areas indicate the misclassified cases (8.6%).

TABLE 2. PERCENTAGES OF MISCLASSIFIED CASES FOR THE MEASUREMENTS USED IN DISCRIMINATORY ANALYSIS

Measurements Used	*Percentage of Misclassifications*
Glabello-occipital length Auricular height Maximum bizygomatic diameter	8.6
Omitting glabello-occipital length	9.7
Omitting maximum bizygomatic diameter	12.6
Omitting auricular height	17.1

analysis allows the greatest chance for misclassification. This is also substantiated by the fact that auricular height had the highest "t" value for the difference between means for the two samples (Table 1). We have used this method of presenting these results, chiefly because our two samples are of unequal size. Rao (1952) discusses this problem at some length, but we felt that the exceedingly involved statistics would not add enough to the accuracy of classification to warrant their use in this paper. The technique for calculating the amount which each variable contributes to the over-all results is also discussed in Rao (1952: 252). For samples of equal size there is a t-test based on the data in the analysis of variance table which is very convenient to use in determining the proportion of errors of classification to be expected when applying the linear discriminant function (Pons 1955; Thieme and Schull 1957).

Our next analysis is based on measurements of the right femur. Table 3 gives the comparative statistical values. Here again the means of the three measurements differ significantly between groups. Figure 3 presents these data in graphic form and, as with the cranial data, considerable overlap exists between samples. Maximum femoral length (X_1), midshaft circumference (X_2), and subtrochanteric diameter (X_3)

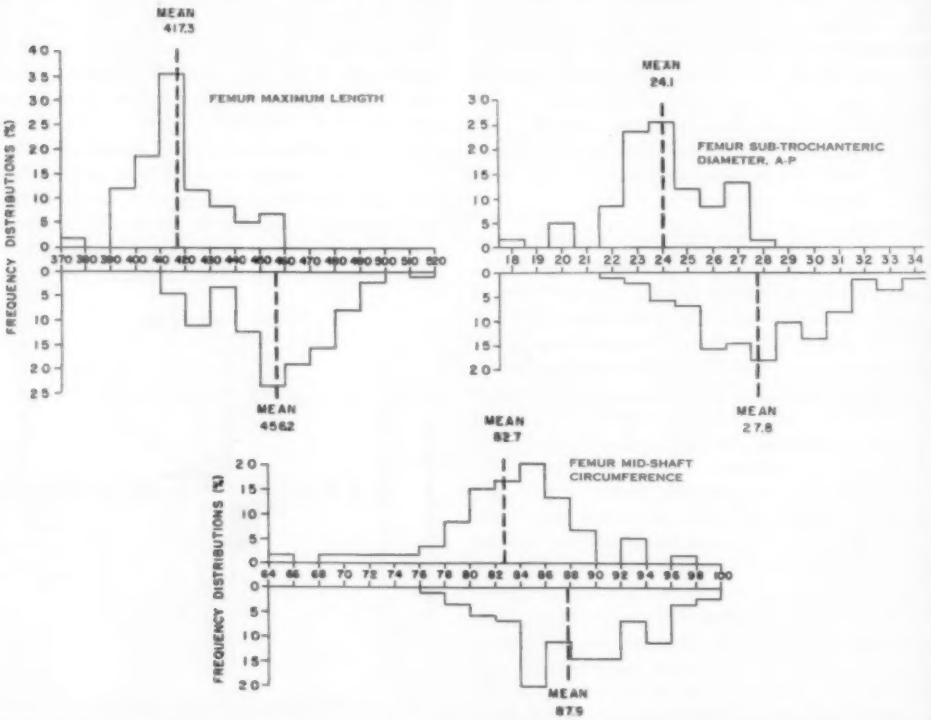

FIG. 3. Comparative frequency distribution of the three postcranial measurements used in discriminatory analysis of two Californian skeletal populations. The series from southern California (N = 59) is above the horizontal scale of millimeter measurements; the central Californian series (N = 90) is below.

Table 3. Comparative Statistical Values of Measurements of Right Femur (in millimeters)

Measurement	*Number*	*Group*	*Mean*	*Standard Deviation*	*"t"*
Maximum length	59	Southern California	417.25	16.17	12.31*
	90	Central California	456.16	20.24	
Midshaft circumference	59	Southern California	82.69	5.58	5.89*
	90	Central California	87.86	4.93	
Subtrochanteric diameter (a-p)	59	Southern California	24.05	1.99	9.86*
	90	Central California	27.82	2.43	

* Significant at greater than the 1% level (2.61).

combine in the following way to discriminate between the two populations:

$$U = X_1 - 1.6321\,X_2 + 5.9314\,X_3.$$

In the original calculations, the smallest lambda (λ) coefficient, belonging to maximum femoral length, is set equal to unity and the other coefficients are adjusted accordingly. The critical index value is 451.37.

Six of the 59 southern California cases are higher than this value, while 15 of the 90 cases from central California are lower. This means that 14.1% of the total 149 cases have been misclassified by this linear discriminant function (Fig. 4). The analysis of variance, however, still shows that the populations differ significantly, with $F = 65.51$. All the lambda (λ) coefficients exceed twice their calculated standard errors, indicating that all of the measurements are useful in discriminating between the two groups. As with the cranial data, we again did discriminatory analyses, excluding each variable in turn. The results of these are presented in Table 4. Maximum length, with the highest "t" for significance of difference between means of the two samples, has the most discriminating power.

As a matter of interest, we did still another discriminatory analysis using the two measurements from each of the preceding analyses which had the highest value in discriminating between populations. Statistical values of these four measurements are listed in Table 5. The combination of auricular height (X_1), maximum bizygomatic diameter (X_2), maximum femoral length

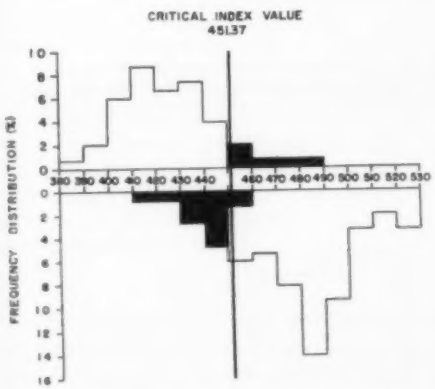

Fig. 4. Distribution of index scores for the three postcranial measurements. The southern Californian series (N = 59 or 39.6%) is above; the central Californian series (N = 90 or 60.4%) is below. The shaded areas indicate the misclassified cases (14.1%).

Table 4. Percentages of Misclassified Cases for the Measurements Used in Discriminatory Analysis

Measurements Used on Right Femur	*Percentage of Misclassifications*
Maximum length Midshaft circumference Subtrochanteric diameter (a-p)	14.1
Omitting midshaft circumference	14.8
Omitting subtrochanteric diameter (a-p)	15.4
Omitting maximum length	18.8

(X_3), and subtrochanteric diameter (X_4) give a slightly better probability of classifying cases in the proper population than either of the other two analyses. The adjusted equation for calculating scores

$$(U = 5.5027\,X_1 + 2.2787\,X_2 + X_3 + 5.8052\,X_4)$$

gives 1551.54 as the discriminating value between the two groups. Of the 95 cases in the combined sample, only seven have been misclassified by use of this discriminating equation. Two cases are from southern California and the remaining five from central California. This comprises 7.4%

TABLE 5. COMPARATIVE STATISTICAL VALUES OF TWO CRANIAL AND TWO FEMORAL MEASUREMENTS (IN MILLIMETERS)

Measurement	*Number*	*Group*	*Mean*	*Standard Deviation*	"t"
Auricular height	31	Southern California	113.61	4.42	9.24*
	64	Central California	123.50	5.06	
Maximum bizygomatic diameter	31	Southern California	134.84	4.92	7.28*
	64	Central California	142.34	4.58	
Maximum femoral length	31	Southern California	416.74	17.87	8.28*
	64	Central California	452.56	20.45	
Subtrochanteric diameter (a-p)	31	Southern California	23.81	1.99	7.46*
	64	Central California	27.42	2.30	

* Significant at greater than the 1% level (2.63).

(Fig. 5) as compared with the 8.6% of the cranial measurement analysis and the 14.1% of the femoral measurement analysis. The two populations differ significantly with F-value of 39.46.

INHERENT ASSUMPTIONS

It would be well to point out here that there are certain assumptions that are inherent in the present method. Because of the nature of their material, as well as the sources from which it is taken (middens, village sites, cemeteries, and so forth), the archaeologist and the physical anthropologist are forced to treat their samples as representative fractions of past populations. They must assume a normal random distribution for age, sex, and gross morphology. They must assume, as we have, that the reference population was a breeding group subject to the same

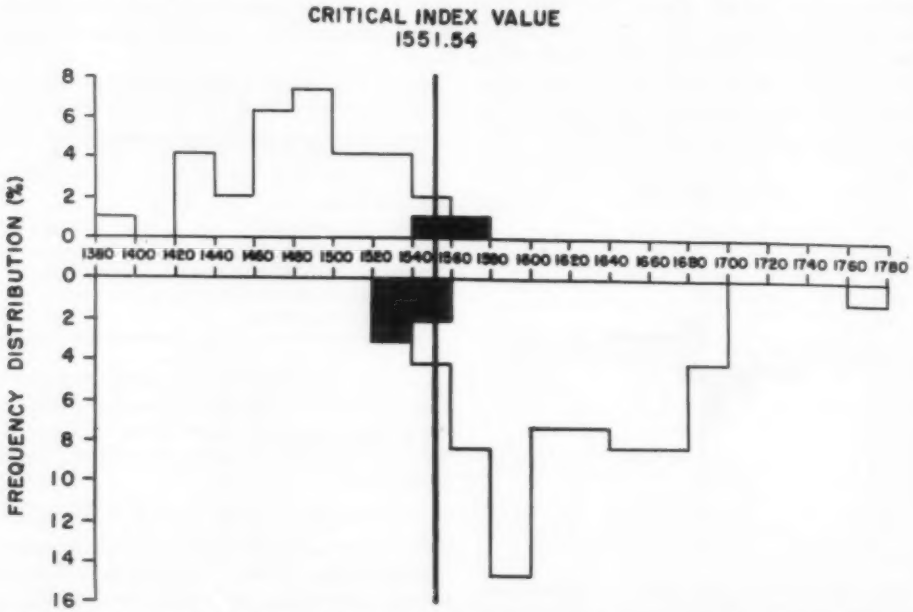

FIG. 5. Distribution of index scores for two cranial and two postcranial measurements. The southern Californian series (N = 31 or 32.7%) is above; the central Californian series (N = 64 or 67.3%) is below. The shaded areas indicate the misclassified cases (7.4%).

pattern of genetic interchange common to documented or contemporary contact tribal units.

In terms of statistical analysis these assumptions place the investigator in a difficult position, since a complete knowledge of the universe from which his sample comes can never be fully realized. Although the above suppositions are standard in sample theory and statistical procedures can be employed to adjust for some of them, subsequent conclusions should be fully qualified. For example, in the present study the size of sample can have a great deal to do with the final results. Analysis of the cranial data was based on 175 cases, while that of the femoral material was made on 149 cases. By the time we had consolidated the data, taking two measurements from each analysis, our sample size had been reduced to 95 cases for which all four measurements were available. For comparative purposes only, we then ran through the discriminatory analysis on the three cranial measurements, using these 95 cases, as compared with our original analysis of 175. With the reduced sample it was found that 13.7% of the cases would be misclassified as compared with only 8.6% in the larger sample. Thus, differences between the results of these two analyses of cranial data may have been due to the size of the samples. Also, if any of the extreme cases were included in the smaller sample, results would be correspondingly biased, and the probability of correctly classifying cases would be poorer.

Both the archaeologist who collects the skeletal material and the physical anthropologist who analyzes it are well aware that their evidence represents unknown fractions of hypothetical populations inhabiting indefinite geographical areas whose times of occupation are, at best, only approximate. Thus, methodology should be carefully applied with a quantitative thoroughness that acknowledges the intrinsic limitations of such evidence and subsequent interpretations should be expressed in terms of probability rather than unqualified fact.

Application

It was our intention to apply the present technique to a small sample of skeletal material from localities adjacent to the two tested areas. However, published anthropometric data for California is not abundant, and what studies we could find dealt mostly with skulls where the auricular height measurement (required for our method) was omitted. As a result, we have metric values for one skull that came from a shellmound on the south shore of San Francisco Bay and must rely on this evidence alone for a demonstration of application. Although this is not an adequate test, the discovery of isolated skulls represents a typical classificatory problem for the investigating anthropologist. Thus, the following analysis was made.

The metric readings for the three discriminating cranial measurements (glabello-occipital length, auricular height, maximum bizygomatic diameter) are 171, 109, and 131 millimeters respectively. An index score is derived by substituting in the proper equation:

$U = -171 + 3.6383 \times 109 + 1.5373 \times 131;$

$U = 426.96$, a score that falls well below the critical value of 460.53. We may conclude from this that the specimen from San Francisco Bay is metrically related to the southern California group rather than to the sample from central California.

Partial substantiation for our findings may be found in Gifford (1926: 250, Map 2) who demonstrates by means of average cephalic indices that the San Franciscan Bay peoples are more closely related to those from the Santa Barbara region than to populations from the Sacramento–San Joaquin delta area. He also lists (page 242, Table 32) 13 indices and measurements that show differences between these three areas. Again, the San Francisco skulls more nearly approach those of Santa Barbara (in eight categories: three indices and five measurements) than they do the central California specimens (in five categories: one index and four measurements). We have demonstrated this same relationship with the more concise technique of discriminant function which is based on fewer variables.

Concluding Statement

Due to the inherent difficulties of assigning individual skeletal material to its parent population, we have demonstrated a statistical procedure, the linear discriminant function, that results in an unusually small percentage of misclassification for two California samples. If metric data for the auricular height, maximum bizygomatic diameter, maximum femoral length, and subtrochanteric diameter (a-p) are available for unknown remains, the probability for accurate affiliation is approximately 92.6%. A somewhat smaller probability of classification (91.4%) may be reached by using three cranial measurements

(glabello-occipital length, auricular height, and maximum bizygomatic diameter).

Since the type and range of morphological differences between the two California groups do not represent those for all populations, the present equations are not applicable outside of the tested area. To solve similar problems of association in other localities, discriminatory equations should be calculated and critical index values established for samples of probable parent groups. Moreover, combinations of measurements suitable for one area are not necessarily so for others. Thus, we recommend that a variety of combinations be tested to demonstrate the highest probability of classification. Once established, tables of critical index values may be used as standard tools for skeletal classification.

Acknowledgments. This study was done while the senior author was serving as physical anthropologist at the Quartermaster Research and Engineering Center, Natick, Massachusetts. The authors wish to express their gratitude to Russell W. Newman and Agnes M. Galligan for their kind assistance and helpful criticism.

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THE LITTLE HARBOR SITE, CATALINA ISLAND: AN EXAMPLE OF ECOLOGICAL INTERPRETATION IN ARCHAEOLOGY

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THE ISLANDS off southern California have attracted archaeological attention since the 1880's, yet actual site reports on island archaeology are virtually nonexistent. This report presents data on excavations at Little Harbor, Catalina Island. It is the first published site report for Catalina Island and the first complete description of a site excavation for the Channel Islands as a group. Chronologically, the radiocarbon dating of the site provides a key reference point for time placement of several southern California complexes.

Catalina is 27 miles from Los Angeles harbor and is the second largest of the eight islands off the southern California coast. It is 22 miles long and about eight miles wide at the widest point. The island has an exceedingly steep and rugged topography with only a few sheltered bays and level areas attractive as village locations. All such locations have been built over by recent settlements, and the principal archaeological sites on the islands are now obliterated. However, numerous small sites remain, several of which are worth excavation.

Little Harbor is on the seaward side of Catalina. There are actually seven sites which border on or overlook Little Harbor, but the geographic designation is applied to the site described here. Of the seven sites, at least two were virtually destroyed by unscientific digging some years ago; the remainder, except for the site reported here, are either very small or badly eroded. Excavations at the Little Harbor site were carried out with the assistance of U.C.L.A. students at various times from 1953 to 1955. A number of weekend trips were made; in addition a small crew was able to work at the site for two weeks in August, 1954 and one week in April, 1955.

CULTURAL PLACEMENT

The Little Harbor site contains a complex which fits into what Wallace (1955) has recently called the Intermediate period. No detailed site report has so far been available for this time — a crucial period during which the cultures of southern California were developing the distinctive maritime adaptation represented ethnographically by the Chumash and Gabrieliño, and archaeologically by the cultures referred to as Canaliño, or Late. Although site reports are available for the coastal manifestations of the last 2000 years or so (Orr 1943; Meighan 1954) and for the ancient lithic assemblages of the Pacific coast (Treganza and Malamud 1950; Rogers 1929; Wallace 1954; Wallace and others 1956; Peck 1955; Walker 1951), the Intermediate cultures have remained nebulous despite the many years of more or less random collecting activities on the part of local institutions and private collectors.

The oldest known sites in southern California are characterized by deep-basin metates and an abundance of coarsely chipped choppers, scrapers, and pulping planes. Through time, these complexes alter into the late and protohistoric cultures containing finely chipped points, mortars and pestles, and abundant evidence of ocean fishing as a major resource. The Little Harbor site falls in the transition between these two cultures and provides some understanding of the shift from a land-oriented economy to one dependent almost entirely on the sea.

Precise cultural affiliations for the Little Harbor site cannot be worked out at present. One of the major difficulties is that the previous descriptions for this region (Orr 1943; Olson 1930; Rogers 1929) are based heavily upon cemetery finds and burial associations. The Little Harbor collection, however, is exclusively made up of material found in midden refuse. The collection could therefore be part of a previously defined cultural complex which cannot be recognized because of the difference between midden artifacts and mortuary artifacts. No doubt there is considerable overlap between the two classes of finds; yet they are not strictly comparable in a qualitative sense and are even less similar in a quantitative comparison.

A second difficulty arises from a considerable confusion in the use of cultural names for southern California, with different writers using the same names to refer to somewhat different cultural manifestations. This situation is due as much to the archaeology as it is to the archaeologists, since the prehistory of the region certainly contains at least a dozen distinctive but related cultural complexes, none of which has yet been precisely and fully defined.

For these reasons, I do not feel justified in classifying the Little Harbor site as a manifestation

FIG. 1. Aerial view of Catalina Island, looking southeast. The Little Harbor site is shown by the arrow at the lower left.

of any of the known archaeological complexes, and I am equally hesitant to add a new culture name to an already topheavy and much abused terminology. The easy solution is to fit the Little Harbor site into one of the very broad categories proposed by Wallace (1955) in his useful synthesis. Within this framework, Little Harbor is certainly one of the Intermediate sites; until more site reports are available it would be unsound to suggest a more precise cultural assignation. Trait similarities between Little Harbor and other California cultures are discussed in the conclusions.

CHRONOLOGICAL PLACEMENT

A single radiocarbon date of 1924±250 B.C. was obtained from charcoal secured from the basal levels of the midden (M-434, 3880±250 years; Crane and Griffin 1958: 1121). At the point from which the charcoal came, the midden is only 24 inches deep; hence the possibility of contamination by plant roots (of grass and cactus) must be considered. I believe this source of contamination was eliminated because the charcoal came from beneath large and thick abalone (*Haliotis*) shells which rested on the submidden clay. Upon lifting up the shells they were found to be filled with soft soil containing midden refuse in the form of shell fragments, very fresh-appearing fish bones, and considerable charcoal in fragments up to a centimeter or so square. No visible plant roots were present. Charcoal was collected from three of the sheltered pockets of midden material to get enough for a radiocarbon assay; all the shells were on the same level and within a few inches of one another. Since the midden proper contained no visible fragments of charcoal and showed considerable alteration of the fish bones present (discoloration and surface coating of calcareous material), I believe that the dated charcoal was completely protected from ground water or plant rootlets.

The date of just under 4000 years ago is consistent with other evidence, including the geological features (suggesting possibility of raised sea level when site was occupied) and the faunal remains. Both shell species and such fish forms as *Pimelometopon pulchrum* (California sheepshead) indicate water temperatures as warm as

or warmer than the present. The date is close enough to the end of the Altithermal period that such a situation is to be expected.

Although it is hazardous to rely too heavily on a single radiocarbon date, there is no reason to question the accuracy of this particular determination. The date is a significant one since it is the only southern California date in this particular time range; all the other dates obtained to this writing are either a couple of thousand years older or a couple of thousand years younger than the Little Harbor date. A second point is that

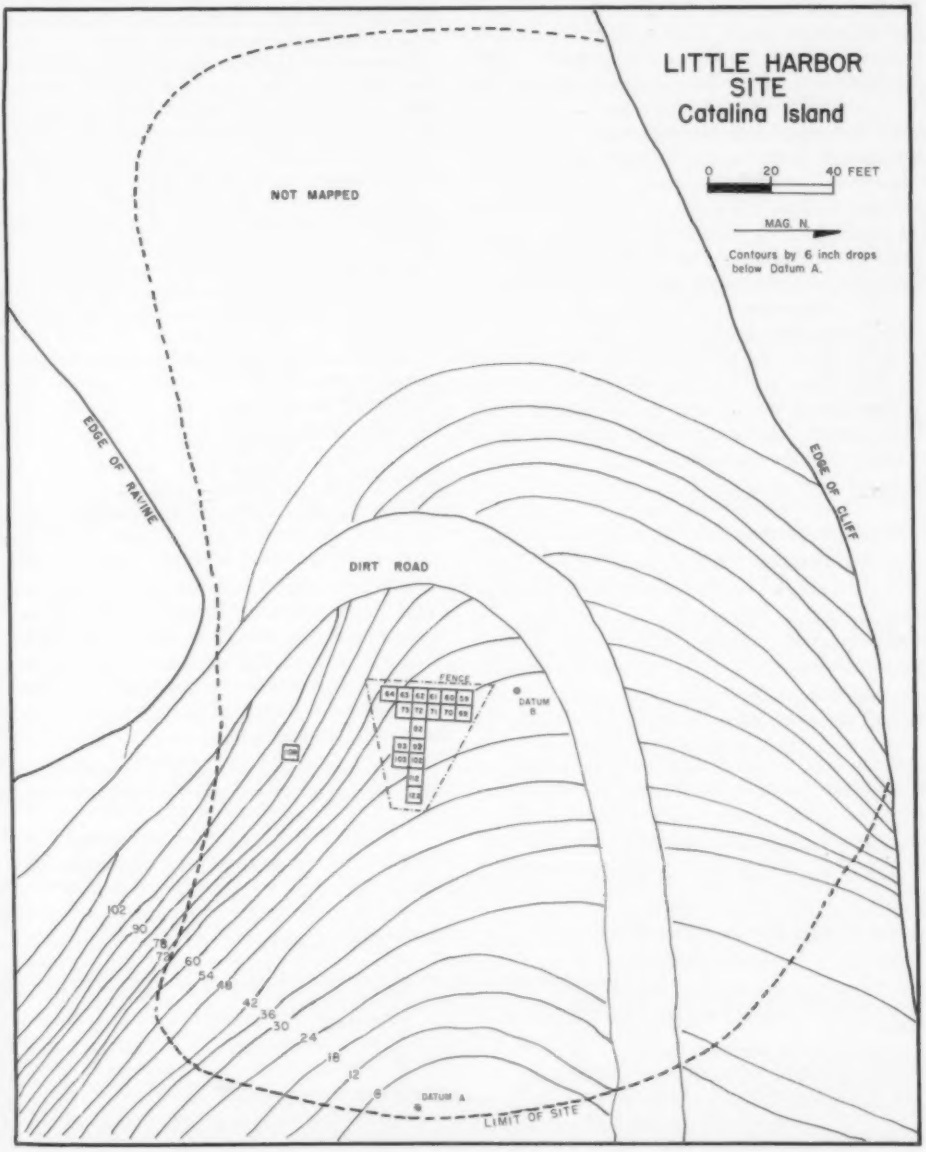

FIG. 2. Map of the Little Harbor site.

this is the only date presently available for the Intermediate cultures of southern California. Wallace (1955: 223) expressed the generally-held opinion that the Intermediate cultures occupied the time period from about 1000 B.C. to A.D. 1, but Little Harbor site forces a revision of these dates since it dates from roughly 2000 B.C. There is nothing about the site, either in its artifact inventory or the degree of midden alteration, to indicate that the site should fall toward the beginning of the Intermediate period. On the contrary, compared with other sites in southern California, Little Harbor gives a distinct impression of lateness; the Intermediate cultures must therefore date from about 1000 B.C. back to perhaps 4000 B.C. This in turn pushes back the time period for the earlier remains (Oak Grove, Topanga, and allied cultures) to a greater antiquity than has previously been considered possible. On the basis of dates recently obtained from Santa Rosa Island, plus others from San Diego County sites, we must now recognize that the deep-basin metate cultures are in part pre-Altithermal in age (greater than 7000 years B.P.); the oldest of them are probably contemporaneous with Folsom man.

The Site Area

The Little Harbor site is located on one of the many headlands extending into the Pacific from the rugged ridges that make up most of Catalina Island (Fig. 1). The site is a shell midden, 200 by 400 feet, with a maximum depth of 48 inches and an average depth of about half that (Fig. 2).

Looking at the modern physiography of this portion of Catalina, the Little Harbor site seems to be located in a poor spot. It has no protection from wind and fog. It is 250 feet above the ocean, and the site is bounded on the ocean side by nearly vertical cliffs, making a round-about hike necessary in order to reach the beaches. There is no fresh water at the site, and a descent into the canyons on either side is necessary for that essential requirement. About the only apparent advantage of this particular location for settlement is that it is a fairly extensive flat area and such are not common on the island.

Although other sites on Catalina Island are in remote interior spots, they appear to be trailside camps rather than semipermanent villages of the Little Harbor type. This, coupled with the observation that the lower-elevation sites at Little Harbor are considerably more recent in time, leads me to believe that local conditions were somewhat different at the time the Little Harbor site was occupied and that during its occupancy the site was not as unfavorably situated as it now appears to be. Perhaps the site area supported trees or some other cover which made it attractive for settlement. Also, changes in sea level probably inundated portions of the lowland and hence the beaches were located differently from the present. However, looking at the topographic maps it is difficult to see any minor fluctuation in sea level making much difference to inhabitants and it is difficult to conceive a major change in sea level for the time period of the site.

Vegetation of the site and its immediate environs is sparse, consisting of thin grass, cactus, and small shrubs. The generally barren aspect is partly the result of cattle grazing the region, but there is no evidence to show that the site itself was very different in aboriginal times. Old photographs of the region (taken 60 or 70 years ago) show it to be much as it appears today, and except for decreased grass cover the area is probably little changed.

The Midden

Although superficially similar to other shell middens along the California coast, the Little Harbor midden proved to have a number of unusual features. These combined to slow down the excavation to the point where it required a man-day to examine only about half a cubic yard of midden material.

The features necessitating such slow work included: 1. the occurrence of great numbers of whole *Haliotis* shells

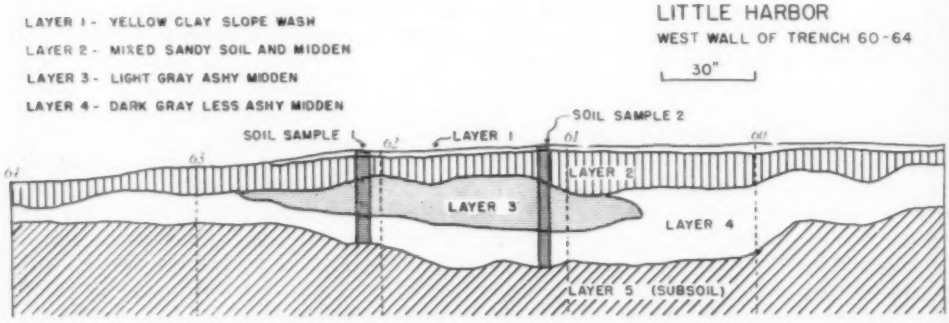

Fig. 3. Profile of the west wall of Trench 60-64, Little Harbor site.

containing hard packed midden, each of which had to be examined, since small artifacts were frequently inside the shells; 2. the high concentration of shell and other faunal remains, which made it impractical to screen the material; 3. a partial cementing of the upper and lower levels, making the midden so hard that picks had to be used.

This hardening is not uncommon with the older southern California middens, and it appears to result from the calcium carbonate in the shells leaching out into the soil. The calcium carbonate may then be redeposited on bones and artifacts, and in fact many of the Little Harbor specimens bear a calcareous deposit a millimeter or more in thickness. The Little Harbor midden was relatively soft and ashy in the intermediate levels (12 or 18 inches to 24 inches), but since not much of the sample was in this depth range the digging proceeded quite slowly. Even in the soft layers, exposed cuts in the midden tended to harden on exposure to air. Two 4-inch-wide columns cut into the wall maintained their shape exactly more than a year after they were dug. Broken shells sticking out of the cut bank are held so firmly that they may cut a person who inadvertently bumps into them.

A profile of the midden is given in Figure 3. Of particular note is the 6-inch layer of slopewash over the flat parts of the site. This material consisted of clay washed in from above; the slope and rainfall being what they are, this thickness of slopewash suggests a rather long time of deposition. The steeper slopes of the site have no clay cap, presumably because of surface erosion.

The excavated sample comprised 19 pits 5 feet square; since many of these were very shallow the total digging included only 26 cubic yards of midden. However, even this small amount of midden yielded a surprising quantity of objects. A total of 356 artifacts was recovered, or more than 13 artifacts per cubic yard (not including flake scrapers) — a high yield by California standards. In addition to artifacts, the sample contained innumerable shells and more than 6200 bones and bone fragments. There were 238 bone fragments per cubic yard of midden.

The general appearance of the Little Harbor midden is of an extremely concentrated living activity — an intensive exploitation of the environment on a scale seldom seen in shell midden remains in California. The massive accumulation of food remains with relatively small amounts of soil, ash, and rock, makes it hard to believe that any inhabitant of this site ever went hungry.

Internal features of the midden were simple and few in number. The excavated trenches crossed a shallow pit in the submidden, measuring some 20 feet in diameter and forming a basin extending 18 to 24 inches into the sterile material beneath the midden. This physical conformation is closely similar to the house depressions found widely in California until the historic period, and the floor of the pit was carefully investigated for evidence of postholes or other structural indications. No such evidence was found, and on present evidence the pit could be either a midden-filled house depression or possibly just an erosional irregularity of the surface.

One hearth and two accumulations of stones were exposed. The hearth was in a shallow part of the site, resting on the sterile clay with 12 inches of midden above it. It consisted of a 2 by 4 foot layer of fist-sized stones. In and above the stones were many fragments of sea mammal bone (some burned), quantities of whole abalone shells, three birdbone awls, a shell pendant, and a shell bead. There was no ash layer, but the burned bone and small flecks of charcoal throughout the feature identify it as a hearth.

The stone accumulations are briefly described as follows.

Feature 1 — 31 inches deep, resting on submidden material. A heap of stones 14 by 19 inches containing a large piece of shale broken into several fragments, a pitted hammerstone and a plain quartz hammerstone, and a small piece of unworked steatite.

Feature 2 — 13 inches deep, immediately below surface slopewash and resting on hard ash layer. A heap of stones 27 by 21 inches containing 40 angular schistose stone fragments, two beach cobbles, a cobble scraper, a bone wedge fragment, and a notched piece of schist (possibly a net sinker).

These two features were not burned and probably represent stockpiles of stones intended for some ultimate use as artifacts. An alternate explanation is that such features may represent a basket load of house refuse dumped in one place by an aboriginal housewife.

ARTIFACTS

Artifact counts, measurements, and depth distributions are given in Tables 1 and 2. This section includes additional descriptive material and comparative data. The total artifact sample comprises 367 specimens plus an additional hundred amorphous quartz flakes used as scrapers. The bulk of the collection is of a utilitarian nature with various kinds of stone tools predominant. General comments on the specimens are given in the same order as in Table 1.

STONE ARTIFACTS

Points. Five types of points are defined (Figs. 4, 5 *a*). All specimens are of quartz and chert available on the island. The size and weight range clearly puts the Little Harbor site in the "large point tradition" as defined by Fenenga (1953: 322).

TABLE 1. INVENTORY OF ARTIFACTS FROM THE LITTLE HARBOR SITE

ARTIFACT TYPE	NO.	MATERIAL	MAX. SIZE, Cm.			AVE. SIZE, Cm.			Depth, In.
			Length	Width	Thick.	Length	Width	Thick.	
CHIPPED STONE									
Points									
Unclassifiable Fragments	21								
Type 1	7	Quartz, chert	6.4	2.5	1.2	4.8	2.1	1.0	0-30
Type 2	8	Quartz, chert	5.5	3.0	1.2	4.2	1.9	0.8	0-36
Type 3	6	Quartz, chert	4.9	2.2	0.9	3.5	1.7	0.7	12-30
Type 4	3	Quartz, schist	6.5	2.3	1.0	6.2	2.1	0.8	0-6
Type 5	1	Quartz	3.3	1.9	0.7	3.3	1.9	0.7	24-30
BLADES (KNIVES)	8	Quartz	7.1	4.3	1.9	6.1	3.5	1.4	0-30
SCRAPERS Used & retouched flakes	ca 100	Quartz							
Teshoa flakes	5	Slate	9.1	6.4	2.3	8.0	6.2	1.9	6-36
Core scraper planes	27	Slate	13.1	10.1	5.9	7.9	6.9	4.1	0-36
HAMMERSTONES	6	Quartz	8.4	8.0	5.0	7.4	6.6	4.4	0-36
NOTCHED SINKER	1	Schist	16.5	9.7	3.6	16.5	9.7	3.6	6-12
GROUND STONE									
MORTARS Type 1	4	Tuff, basalt	See text						0-12
Type 2 (Boulder)	2	Steatite	23.7	18.8	9.6				12-30
PESTLES	5	Cobbles, various	23.0	8.2	6.4	14.3	6.8	5.6	6-30
ABRADING STONES (GRINDING SLABS)	6	Schist, slate	62.0	24.5	4.5				6-30
COBBLE MANOS	6	Small beach cobbles	11.4	7.9	3.8	8.5	6.3	3.3	12-30
STEATITE VESSEL FRAGMENTS	8	Steatite	12.0	8.8	3.3				0-36
"EFFIGIES" Type 1	11	Steatite	6.0	3.0	1.4				0-36
Type 2	1	Steatite	4.6	2.7	1.7				30-36
Type 3	2	Steatite	6.8	1.9	1.4				18-30
CHARMSTONES Type 1	1	Steatite	4.3	0.8	0.7				6-12
Type 2	1	Steatite	14.0*	1.9	1.4				24-30
Type 3	1	Steatite	15.0*	2.4	1.6				12-18
BEADS	2	Steatite	0.8	0.7	0.4				6-30
PERFORATED STONES	13	Steatite, serpentine	11.1	7.6	5.3	6.9	4.9	3.5	0-36
"DISCS"	3	Schist	11.3	9.8	2.8	10.2	7.7	2.2	12-24
OTHER STONE OBJECTS									
NET SINKER WITH ASPHALTUM	1	Cobble	10.7	6.4	4.1				18-24
PITTED HAMMERSTONES Type 1	39	Cobbles, various	21.2	10.7	6.7	11.4	7.9	4.6	0-36
Type 2	2	Cobbles	13.8	10.3	4.5	13.0	9.4	4.1	12-36
TARRING PEBBLES	16		4.5	3.2	2.8	3.3	2.5	1.5	6-42
"SOUVENIRS" Odd pebbles, possible fetishes	5	Various	7.8	4.9	3.0	5.9	3.3	2.1	6-36
BATTERED QUARTZ CRYSTALS	3								
BONE									
BONE TUBES	5	Bird bone, 1 mammal bone							
CUT BIRD BONES	7	Bird wing and leg bones							
PRIES	14	Sea mammal ribs	13.8	3.7	1.4	7.2	2.7	0.9	0-36
FLAKERS	5	Mammal rib, long bone frag	14.0	0.7	0.7				
AWLS	15	Bird wing and leg bones	7.8	1.2	1.2	5.7	0.6	0.5	6-36
FISH GORGES	43	Mammal bone splinters	7.8	0.9	0.8	5.6	0.7	0.3	0-36
DRILLED TEETH	2	Prob. sea mammal				3.5	1.0	1.0	12-24
FISH VERTEBRA BEADS	6								
SHELL									
Ornaments									
SPIRE-LOPPED BEADS Olivella	2								18-24
Conus	22								0-36
BARREL-SHAPED BEAD Olivella	1								30-36
Megathura RING	1								6-12
Haliotis PENDANT	1		3.7	0.8	0.3	3.7	0.8	0.3	
Tools									
Haliotis FISH-HOOKS	2								0-6
PERFORATED Haliotis SHELLS (SCOOPS)	5								12-24

* Reconstructed from fragmentary specimens.

The weights of six entirely complete points ranged from 2.9 to 14.1 grams, average 7.9. However, most of the broken points appear larger, and if six almost complete points are included (with estimations of their original weight) the range includes points up to 16 grams weight and the average is increased to 9.5 grams. The latter figure is probably closer to the actual average weight for Little Harbor points, and it is almost exactly the modal weight of 9.0 grams determined by Fenenga for the "large point tradition." From this, the spearthrower is inferred as the principal projectile weapon. This is a standard interpretation for all of the earlier southern California cultures although physical remains of the actual spearthrowers have so far not been found.

A prominent feature of southern California archaeology in the Intermediate period is the occurrence of long-

stemmed points in various forms; such points are common in Rogers' Hunting Culture (for example, Rogers 1929). The Little Harbor sample is surprising in its complete lack of long-stemmed forms. Possibly this is due to our small sample, but it seems likely that an areal or temporal distinction is reflected here. Presence or absence of such stemmed points will probably be a valuable indicator to subdivisions within the Intermediate period.

The side-notched and leaf-shaped points of the Little Harbor site show a generic similarity to most of the earlier California cultures, including those in northern California. Four types occur in the Early horizon of central California (Heizer 1949) in the same sizes and with similar chipping technique. The Early horizon in central California has a radiocarbon date of slightly over 4000 years (C-440, Johnson 1951: 13) and is thus virtually contemporaneous with Little Harbor. In southern California all of the Little Harbor point types are found along the coast from about the latitude of San Luis Obispo south into Baja California an undetermined distance.

Blades or Knives. Several objects are here defined as knives (Figs. 6 *a-d*, 5 *c*). They are all oblong or leaf-shaped, large, and very crudely chipped by percussion flaking of quartz fragments. Possibly they served as skinning knives, but their rude manufacture suggests that they could be blanks or unfinished tools.

Scrapers. Scrapers include retouched flakes, teshoa flakes, and core scraper planes. Most abundant are the quartz flake scrapers. Hundreds of quartz flakes occur in the site; most of these are waste from artifact manufacture but a significant number of them show used edges. They were probably the primary cutting and scraping tools.

Only five teshoa flakes were recovered, but they are definite artifacts with retouched edges. Their significance lies in the occurrence of this form in other southern California sites, such as Point Dume (Peck 1955: 38).

The numerous core scraper planes conform to a definite tradition of tool manufacture despite their apparent crudity (Fig. 7). All of them are made of beach cobbles;

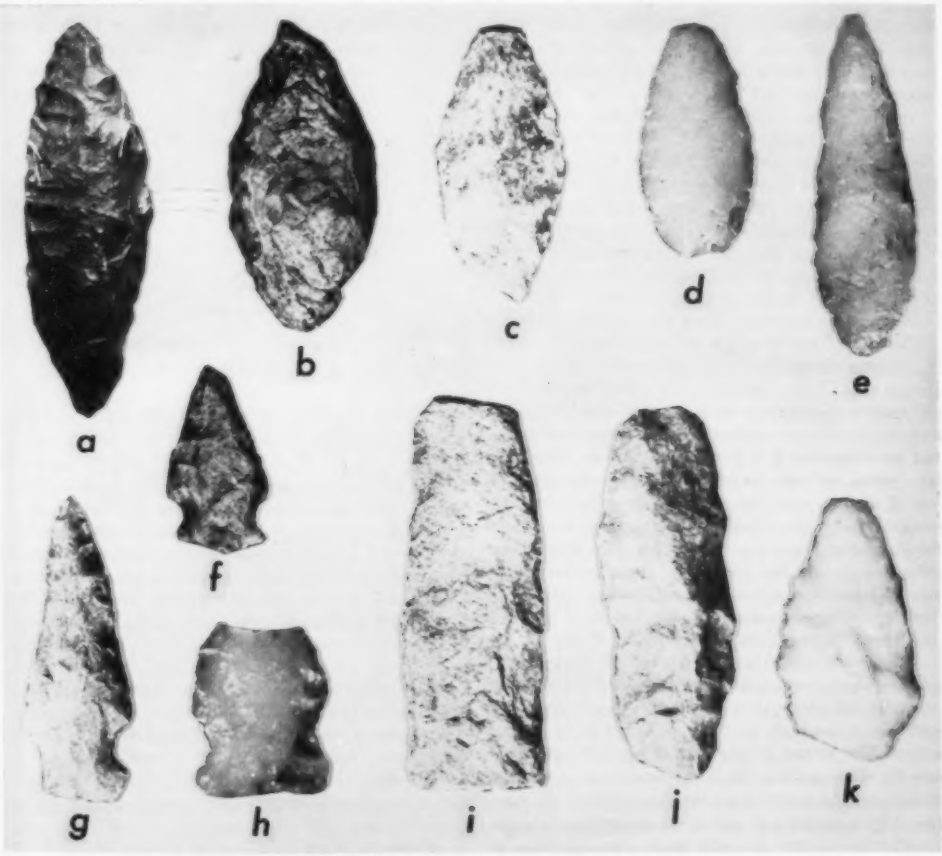

FIG. 4. Projectile points. *a-c*, Type 1; *d*, *e*, Type 2; *f-h*, Type 3; *i*, *j*, Type 4; *k*, Type 5; length of *a*, 6.4 cm., others to scale.

TABLE 2. DEPTH DISTRIBUTION OF ARTIFACT TYPES

Depth Distribution of Little Harbor artifact types	0-6"	6-12"	12-18"	18-24"	24-30"	30-36"	36-42"
PROJECTILE POINTS	9	11	9	9	10	2	0
CORE SCRAPERS	5	5	7	4	2	4	0
"EFFIGIES"	4	0	2	3	2	3	0
PERFORATED STONES	4	2	4	1	1	1	0
PITTED HAMMERS	3	5	13	7	5	2	1
TARRING PEBBLES	0	4	1	1	1	7	2
BONE PRIES	1	2	2	2	3	3	0
BONE GORGES	3	15	13	6	3	2	1
BIRDBONE AWLS	0	5	2	6	0	1	0
CONUS BEADS	2	4	5	5	1	5	0

a hard blue slate is the material selected. At least one end of the cobble is broken off. The resulting flat face is trimmed by percussion flaking to produce a plane with a sharp cutting edge. Because of their simple manufacture, the possibility was considered that these objects might be simple cores, providing flakes which were intended to be the finished tools. However, there are strong arguments against such interpretation. The consistency of size, shape, and material, plus the fact that neither chips nor other kinds of flaked artifacts of this material are found, make it clear that these are finished artifacts, presumably made on the beach and brought to the site for a specific purpose. The function of such crude tools is not evident; perhaps the most logical suggestion is that they were utilized in some way in the preparation of animal skins. Closely similar tools are sometimes referred to as pulping planes and are reportedly used elsewhere in preparing plant materials. Such an interpretation seems unlikely here, however, since the Little Harbor site yields virtually no indications of plant utilization — certainly not enough to justify the quantity of the scraper planes.

Crude scraper planes similar to the Little Harbor examples are common in southern California archaeology and are characteristic of the earlier sites. No doubt such implements are even more common than has been reported, since in some cases they have no doubt not been recognized as tools. Closely similar tools occur at Zuma Beach, in San Diego County, and in other coastal sites ranging south into Baja California. They also were found in abundance at the Tank Site in Topanga Canyon, although this site also produced many tools of this sort which were more precisely and carefully made.

Temporally, scraper planes occur in all of the earlier cultures of southern California, but they also continue into relatively recent times. Although precise dating information is not available, my work in San Diego County suggests that scraper planes were in use there until well into the Christian era. Such implements are also found in sites yielding pottery along the coast of Baja California. Hence the occurrence of such crude implements in southern California sites is not in itself any indication of antiquity. The whole southern California region was marginal and isolated from many of the prehistoric new world developments; crude and simple artifacts are to be expected in all time periods.

Hammerstones. Six fist-sized pieces of quartz show extensive battering on the ends (Fig. 8 *a-d*). These were presumably used for working other pieces of quartz, since quartz cores, flakes, and spalls often occur in the midden.

Notched Schist Fragment. An unshaped piece of local schist is crudely notched by chipping. It may be a net sinker. The specimen was found in an accumulation of stones and ash (Feature 2).

Grinding Tools. Coastal Los Angeles and Santa Barbara counties show a well defined change from manos and metates in the earlier horizons to mortars and pestles in the later periods. This cultural change is not general for southern California. All of the desert region and the coast from San Diego County south into Baja California show a persistence of metates into the historic period. On the other hand, except for isolated and somewhat questionable specimens, no metates are reported from the islands for any time period. Hence the grinding tools found at Little Harbor need not reflect the pattern of culture change characteristic of the adjacent mainland. Mortars and pestles are definitely present in the site. Mortars include small hemispherical forms, shaped inside and out (Fig. 9 *b, d*), and also two which are simply concavities in unshaped rocks. Pestles are beach cobbles of convenient shape (Fig. 9 *a, c, e*).

The site also yielded six fragments of grinding slabs; they are unlike the forms usually called metates or

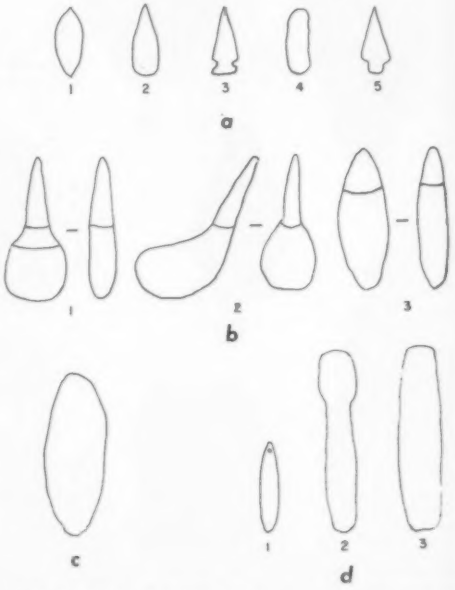

FIG. 5. Idealized artifact types. *a*, projectile points; *b*, "effigies"; *c*, blades or knives; *d*, charmstones; not to scale.

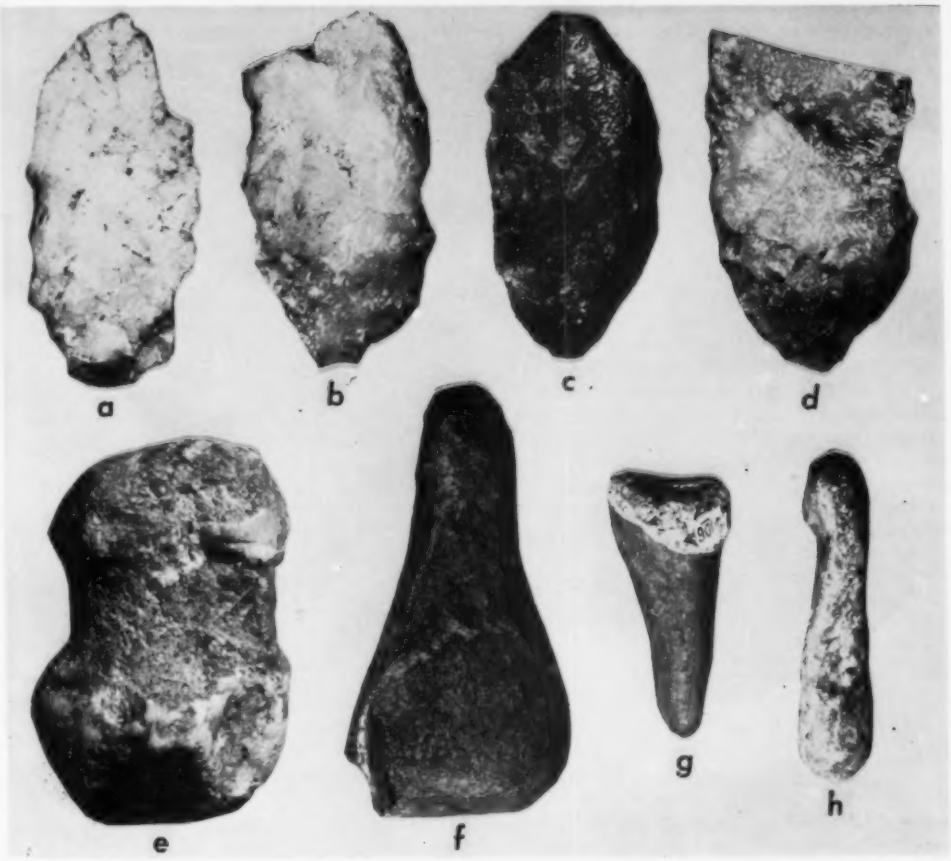

FIG. 6. Crude quartz knives and wave-shaped pebbles. *a-d*, crude quartz knives; length of *c*, about 6.5 cm., others to scale; *e-h*, wave-shaped pebbles selected for their unusual shape, length of *f*, 8.5 cm., others to scale.

milling stones and they are referred to here as abrading stones. The specimens consist of unshaped slabs of schist or slate with a small amount of abrasion on one surface. One fragmentary specimen shows a ground basin-shaped concavity which must have been at least 2 cm. deep. Six objects are here called cobble manos; they are fist-sized round beach cobbles with minor smoothing. They could have been used with the abrading stones but were not found in association. Two of the cobble manos show an orange-red pigment. It is doubtful that these abrading stones with their possible manos were used for seed grinding; they are too few in number and show too slight a use to represent everyday domestic activities. Use in the preparation of a mineral paint is shown by two of the cobble manos; possibly these tools were also used in such tasks as manufacture of shell beads. The abrading stones may even have served as anvils on which shellfish meat was pounded and cleaned.

Steatite Objects. Steatite objects are in general diagnostic of cultural periods in southern California sites. A variety of diversified and elaborate steatite objects occurs in the late sites of the region, along with extensive use of steatite bowls and globular steatite ollas. Virtually all of the steatite in southern California sites appears to be from the extensive quarries on Catalina Island itself (Schumacher 1878; Heizer and Treganza 1944; Meighan and Johnson 1957). The Little Harbor site is only 4 miles from the principal source of steatite in southern California, and hence the steatite objects found here are of particular interest in dating the steatite industry. Since only a few steatite objects were found at Little Harbor, and these of a simple and unspecialized type, it is clear that the site precedes the development of the steatite mining so important in the late and protohistoric periods.

Of vessel fragments, the Little Harbor site produced eight pieces of small hemispherical bowls, some of which

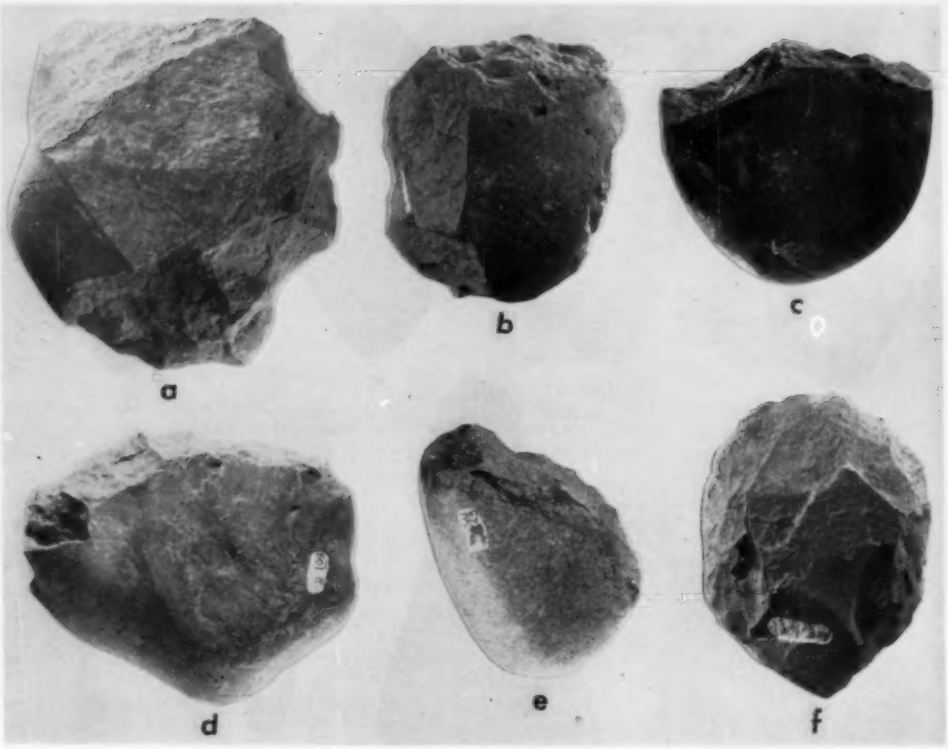

FIG. 7. Core scraper planes. Length of *f*, 8.8 cm., others to scale.

were probably shallow enough to be called dishes or plates. Globular vessels are absent. All of the sherds are of rather poor quality steatite and it looks as if the vessels were made of float pieces rather than quarried material (note that two boulder mortars previously mentioned are also made of steatite, in this case definitely of unshaped float fragments). Other evidences of steatite (Fig. 10) include two small beads, a few perforated globular pieces, and 14 simple but interesting forms that I have called "effigies." All of these objects could be easily produced from surface pieces of steatite without requiring any quarrying activities.

The class of "effigies" includes the three forms represented in Figures 5 *b*, 10 *a-k*. I believe that these are the forerunners of the beautifully made whales, hook-shaped stones, and other effigy forms of the protohistoric Canaliño culture. This inference cannot be firmly validated since intermediate forms have not been found; however, it seems a fair suggestion that the Little Harbor objects are a cruder and simpler expression of the same activities which produced the Canaliño effigies. All of the Little Harbor specimens are much too soft and fragile to have served any functional purpose. They bear no indications of having been worn as ornaments (none is drilled or notched for attachment to a cord) and indeed they are too soft to survive even this sort of use. Whether or not they are actually intended to be effigies of animals, the forms were presumably fetishes of some kind. One of my Type 1 "effigies" was found in Level 2 at the Malaga Cove site, on the coast immediately adjacent to Catalina Island (Walker 1951: 60; Pl. 15 *B*); other examples of these forms have not been noted in the literature. Since the Malaga Cove specimen could well be a trade piece from Catalina, it may provide a cross-date for Level 2 of the Malaga Cove site of somewhere around 4000 years ago. If this is a correct inference, it is a very important one, for Malaga Cove 2 contains many of the characteristic manos and metates of southern California while Little Harbor has none of these. The previously mentioned cultural difference between mainland and islands in this regard is thus partly confirmed.

The Little Harbor types of "effigies" have not been previously recognized as constituting a class of artifacts that may have considerable significance. The small size, fragile nature, and relative simplicity of manufacture make it easy to overlook or discard such specimens, and they are no doubt of more common occurrence than the published reports indicate. The broken-off pointed projec-

tions of the effigy forms are most commonly found (Fig. 10 *f-k*), and recognition of such discoveries may provide a new diagnostic of cultural affiliation for southern California complexes.

The final group of steatite objects includes 13 examples of the perforated stones commonly found throughout southern California (Fig. 11). Although these are not found in the earliest sites, they occur pretty generally otherwise. They have been variously interpreted as sinkers and digging stick weights. However, some of the perforated stones are too small to have served in this way, and they must have been used for other things as well. It should be noted that these artifacts are not made out of the softest varieties of steatite; a tougher rock going toward serpentine is preferred, and some examples are made of tuff or sandstone. This suggests that the objects had a functional purpose and had to stand up under some kind of utilitarian activity.

Steatite objects of relatively common occurrence in late sites (both on the islands and the mainland), but which are absent from the Little Harbor collection, include the following: globular vessels, large beads and pendants, well made animal effigies, miniature canoes, griddles, pipes, and grooved arrowshaft straighteners.

Charmstones. Three Little Harbor specimens conform closely to a class of objects found widely throughout California. Ethnographic accounts demonstrate these objects to be of magical and religious significance in late time, and charmstones appear to be a deeply rooted part of California culture. Charmstones are much more abundant in the interior valleys and northern California than they are along the south coast, but sporadic examples have been found throughout southern coastal California. The Little Harbor specimens are of three types, all of which occur elsewhere in California (Fig. 5 *d*). They include:

Type 1: A miniature steatite cylinder with a perforation at one end (Fig. 10 *p*).

Type 2: A serpentine flattened cylinder (Fig. 10 *q*). The single example is broken; it was repaired aboriginally by cementing the pieces together with asphaltum but only one piece was found. We cannot tell whether the specimen was perforated at one end or not, but both perforated and unperforated examples of this form are known to occur.

Type 3: A phallic example made of blue slate (Fig. 10 *o*). This specimen also has one end missing and might have borne a perforation in the missing portion.

Types 1 and 3 are identical in form to examples found in the Early central California sites near Sacramento. Type 2, being fragmentary, cannot be related to forms from other areas. It seems likely that true charmstones are diagnostic of older sites (over 2000 years) in southern California, although they appear until the historic period in central California. The implications are that charmstones reflect a cultural interest which developed very early in central California and persisted there in a strong form, whereas the peoples of southern California shared this interest only slightly and only in earlier periods.

Other Stone Artifacts: An unshaped beach cobble bore a band of asphaltum which reveals the impression

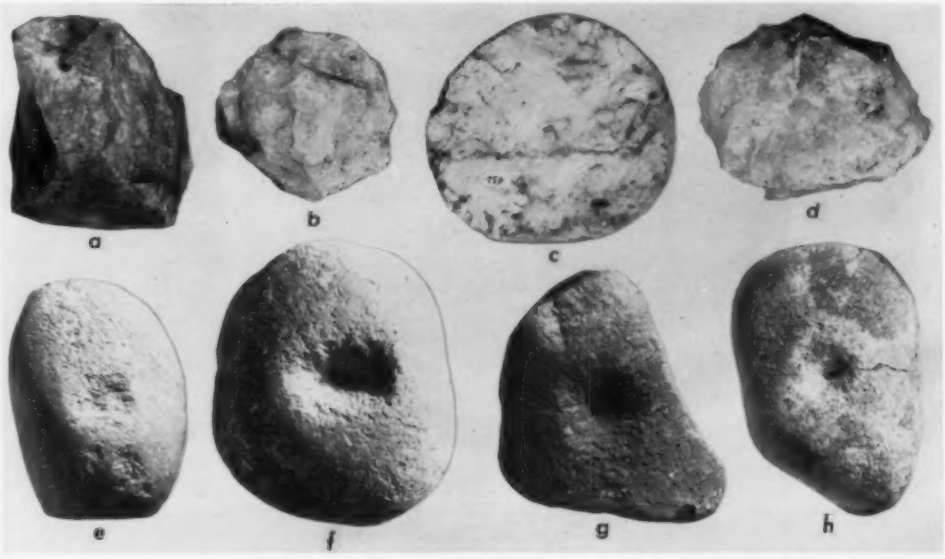

FIG. 8. Quartz and pitted hammerstones. *a-d*, quartz hammerstones, length of *a*, 7.9 cm., others to scale; *e-h*, pitted hammerstones, length of *e*, 13.7 cm., others to scale.

FIG. 9. Mortars and pestles. *a*, *c*, *e*, pestles, length of *e*, 15.6 cm., others to scale; *b*, tuff mortar, 12.3 cm. in diameter; *d*, steatite mortar, 23.7 cm. in diameter.

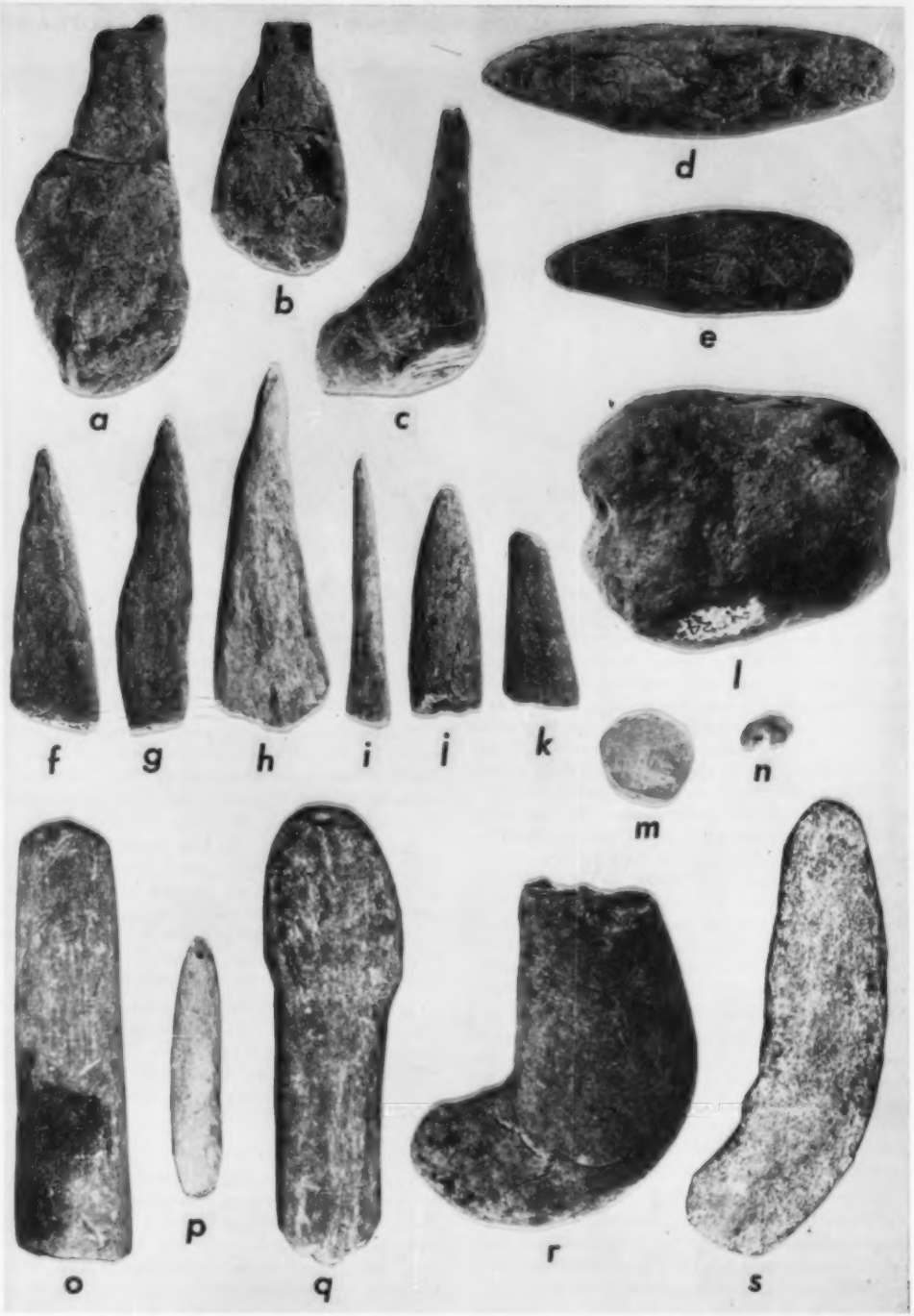

FIG. 10. Small objects of steatite. *a*, *b*, Type 1 "effigies"; *c*, Type 2 "effigy"; *d*, *e*, Type 3 "effigies"; *f-k*, broken tips of "effigies," probably all from Type 1 forms judging from the flattened cross section; *l*, worked piece of steatite with a pit drilled in each end; *m*, disc, possibly a bead blank; *n*, bead; *o*, Type 3 charmstone, blue slate; *p*, Type 1 charmstone; *q*, Type 2 charmstone; *r*, *s*, shaped pieces of steatite, use unknown; length of *a*, 6.4 cm., others to scale.

FIG. 11. Perforated stones. Length of *b*, 7.1 cm., others to scale.

of a two-ply "S" twist cord. Presumably used as a sinker, this is a rare artifact type not previously reported.

One of the commonest Little Harbor artifacts is the pitted hammerstone (Fig. 8 *e-h*). Natural beach cobbles of convenient size bear evidence of battering on edges or ends. Two of the 41 examples are intentionally shaped on all ends and surfaces; they would be considered manos except for the pits pecked into the center of each side. It is not impossible that these two examples are actually reworked manos; in any case they are here classified as a second type of pitted hammerstone. The function of pitted hammerstones is a question of some interest. Their abundance shows that they were used in some everyday activity involving pounding, yet they do not show enough wear to be interpreted as stoneworking tools. Most likely the pitted hammerstones were used for pounding the meat of various shellfish, in particular the tough muscular foot of the abalone (*Haliotis*), which is virtually inedible unless the muscles are relaxed by a pounding process. Two observations support this interpretation:

1. The Little Harbor site contains very abundant remains of *Haliotis* and this must have been an important food resource. An attempt has been made to correlate the occurrence of pitted hammerstones with an abundance of *Haliotis* shells at other California sites, but the published information on shell species in the middens is too meager to demonstrate the correlation.

2. Anyone pounding shellfish would be likely to have wet hands. If the pounding was done with a beach cobble some roughening or pitting of the surface would be essential to avoid smashed fingers. The pitted hammerstones are ideally suited for pounding wet shellfish meat.

Sixteen small pebbles with a coating of asphaltum were found at Little Harbor. In historic times these are known to have been used as tarring pebbles, being heated and rolled around in a basket containing tar to produce a waterproof interior coating. There is no reason to assume that the present examples had any other purpose; their chief interest is in demonstrating considerable age for this waterproofing technique.

The remainder of the stone tools includes the following:

1. Three battered quartz crystals. These are widely used in all periods and areas of California and appear to have been used in magic and curing ritual. The present examples are irregular pieces probably derived from clear quartz occurring on Catalina Island.

2. Six beach pebbles that have been worn by the sea into odontiform or various grooved shapes (Fig. 6 *e-h*). Most have layers of quartz in them which produced differential weathering and banded colors. Since they are quite similar to one another in size and general appearance, and since other kinds of beach stones were not found, they may have been saved as fetishes of some sort.

3. Three shaped fragments of schist. Ranging from 7 by 8 cm. to 10 by 11 cm., they are roughly shaped into the form of a disc about 2 cm. thick. They are too soft to be functional as tools, and since the surfaces are not smoothed these may be unfinished objects. There is no evidence of their intended function.

BONE ARTIFACTS

Tubes and Cut Bird Bones. A few segments of bird bones, probably used as beads, were recovered (Fig. 12 *h-j*). Several of the articulating ends of bird bones were found with scored and broken shafts (Fig. 12 *a-g*); these are most likely waste from the manufacture of beads. One additional tube is noteworthy; it consists of a cut segment of heavy mammal bone with the interior hollowed out and the exterior edge decorated by two rows of drilled pits (Fig. 13 *n*).

Bone Pries. Fourteen examples of bone prying tools were found. They are of heavy sea mammal bones (ribs for the most part) shaped on all surfaces and with one end beveled to a thin edge (Fig. 13 *k, m, o-q*). Such implements would have functioned well for prying *Haliotis* shells from the rocks. Modern collectors of *Haliotis* use a tire iron for the prying tool; the bone specimens are closely similar in size, shape, and thickness to the end of the modern metal pries. Indentical pries from later sites frequently show asphaltum at the thick end; the leverage was apparently improved by affixing the pry to a wooden handle (Meighan and Eberhart 1953: 122; Fig. 40). The Little Harbor specimens show no asphaltum, but since most of them bore calcareous deposits from the midden it is not possible to be certain that the specimens were not hafted originally.

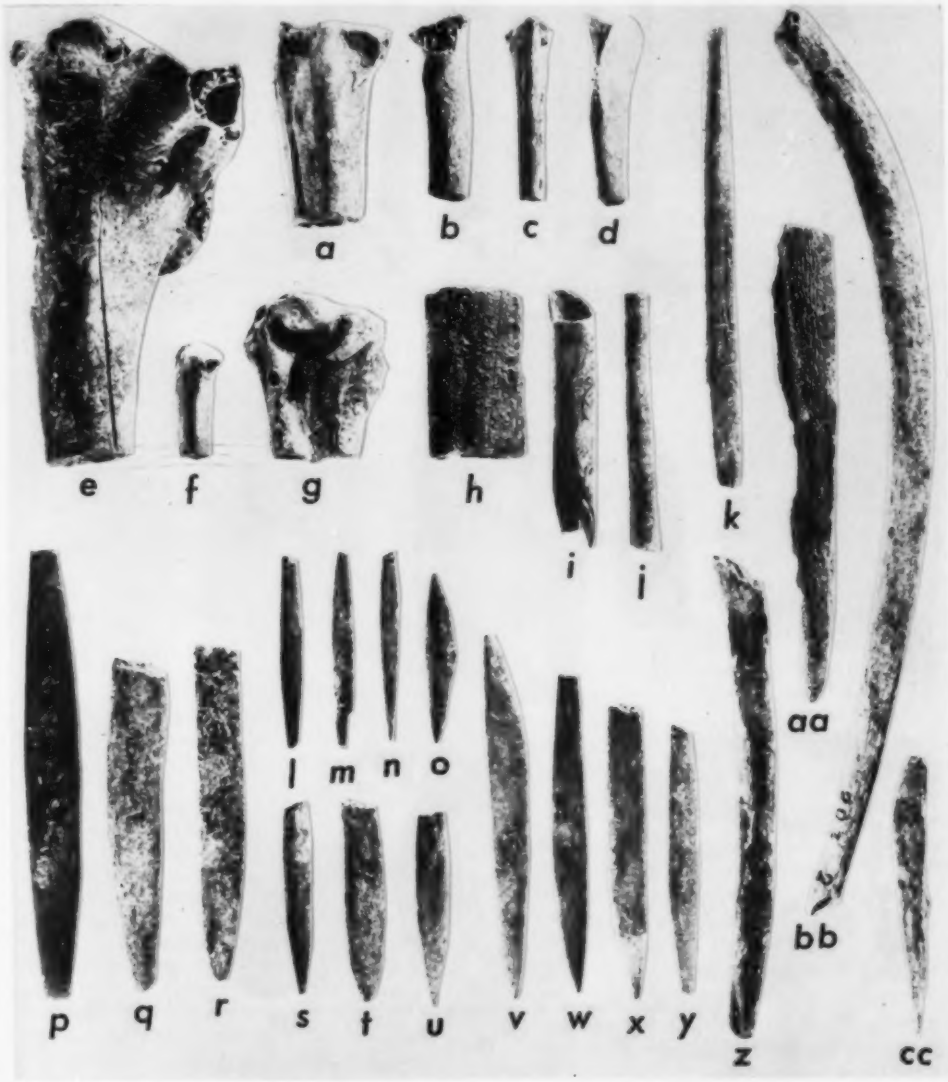

FIG. 12. Bone objects. *a-g*, cut articular ends of bird bones; *h-j*, bird bone tubes; *k*, cut mammal rib; *l-y*, bone fish gorges; *z-cc*, flakers of sea mammal ribs; length of *x*, 6.3 cm., others to scale.

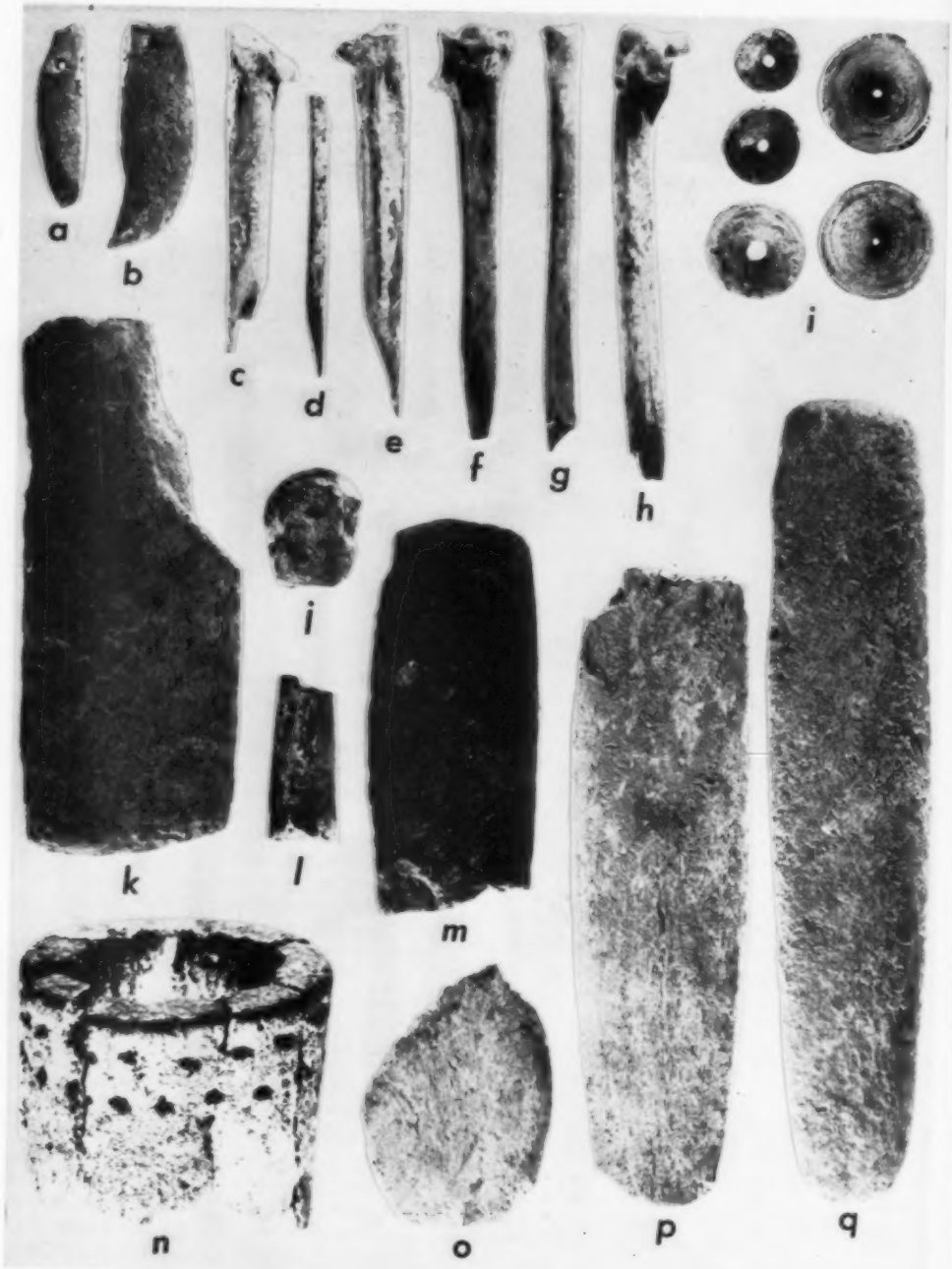

FIG. 13. Bone objects. *a, b*, perforated animal teeth; *c-h*, bird bone awls; *i*, beads made from fish vertebrae; *j*, cut articular end of a deer cannon bone; *k, m, o-q*, abalone pry bars; *l*, midsection of a bone awl; *n*, pitted bone tube of mammal bone; length of *o*, 13.8 cm., others to scale, except *n*, 4.3 cm. in diameter.

Flakers. A few bone pieces bear blunt ends and were probably flaking tools for the preparation of projectile points (Fig. 12 *z-cc*). Many of the projectile points appear to have been made exclusively by percussion chipping, but a few definitely have pressure retouching. The small number of flakers is consistent with the small amount of pressure flaking revealed in the artifact sample.

Bird Bone Awls. Fifteen specimens of this characteristic southern California artifact were found (Fig. 13 *c-h*). Bird bone awls have a long history in southern California, and although they have not been found in the oldest sites this may be partly a function of preservation factors. The Little Harbor specimens are quite brittle and tend to break up into splinters with any sort of rough handling. Once introduced, bird bone awls persisted in southern California until the historic period. Although they are not uncommon in mainland sites, awls made from bird bones are concentrated in the offshore islands where suitable mammal bone was not generally available for awl manufacture. Birdbone awls are rare to absent outside of the southern portion of California (Gifford 1940).

Fish Gorges. The 43 bipointed splinters of bone used as fish gorges represent the most common artifacts in the Little Harbor site (Fig. 12 *l-y*). The occurrence of gorges is not diagnostic of chronological placement, since they occur into the historic period. However, the relative quantity of such artifacts is very significant, since the later sites utilize curved shell fishhooks very extensively. At Little Harbor, fragments of two shell hooks were found. The ratio of 43 gorges to two shell hooks is not found in late sites where this proportion is likely to be reversed.

Bone Ornaments. Two canine teeth (assumed to be from sea mammals) bear a drilled perforation near the root end (Fig. 13 *a, b*). A number of fish vertebrae have central perforations permitting use as beads (Fig. 13 *i*).

SHELL

Shell Ornaments. The collection of shell ornaments is rather small and nondiagnostic, which is to be expected in a midden sample. It includes 24 beads made by grinding off the spires of small shells. There are two examples of *Olivella biplicata* and 22 specimens of *Conus californicus*. Both types are nearly universal in southern California sites. The high percentage of *Conus* beads is a little unusual but probably reflects nothing more than the local availability of these two species.

One small *Olivella* bead has both ends of the shell ground off to produce a barrel-shaped bead. There is also a single oblong *Haliotis* pendant and a fragmentary ring made from the callus of *Megathura crenulata*. The latter form is common in Canaliño sites and is generally considered to be a late development. Since Little Harbor yielded only one example from the top levels of the site, it is probable that the specimen is intrusive and later in time than the rest of the collection.

Shell Tools. Functional shell objects include two fragmentary *Haliotis* fishhooks, both lacking the line attachment. One specimen was immediately below the surface of the site; the other was in the top 6 inches of deposit. They are interpreted as intrusive, dropped by later visitors to the site. Radiocarbon dates show that shell fishhooks were in use near the northern limit of their distribution in Monterey County by about 1800 years ago (specimens found in Mnt-282 in levels for which there are two radiocarbon dates: Johnson 1951: 19, sample C-628; Libby 1952: 678, sample C-695). Also found were five whole *Haliotis* shells bearing perforations punched from the interior of the shell.

ECOLOGY

The interrelationships between the people of the Little Harbor site and their environment can be defined in greater detail than the archaeologist can usually present. Since our understanding of human expansion and cultural development is directly and intimately connected to our understanding of man as a hunting and gathering animal, a special effort was made to delineate the ecological picture of this site in as much detail as seemed feasible. Of course, limitations of archaeological preservation prevent us from perceiving the total picture. In addition, errors in sampling technique and other problems require that the conclusions be regarded as approximations rather than precise results. Still, an approximation based on testing and measurement is much better than an uncritical guess, and our techniques for analyzing the Little Harbor site do give a rather complete and essentially correct insight into the culture of the prehistoric inhabitants. To assemble the necessary data, several approaches were used.

Plant Foods. Absence of preserved plant remains forces reliance upon such indirect evidences of plant utilization as grinding implements and other artifacts associated with preparation of plant products. This is a poor method and cannot give much more than a rough impression of plant use. In the case of the Little Harbor site, plants appear to have been of minor importance. Catalina Island has very limited plant resources, and the paucity of artifacts which could be used in plant preparation also shows the Little Harbor people to have been little influenced by plant resources. The site shows a predominance of meat in the diet of the people and therefore we are not forced to face the impossible task of measuring plant consumption in detail. The most important plants for economic utilization were no doubt the grasses, providing seeds, and the two native plants of greatest size: scrub oak (*Quercus macdonaldii*) and Catalina cherry (*Prunus lyonii*). Charred seeds of these two forms have been recovered from a proto-

historic Catalina site, and it may be presumed that they also served as food in earlier times.

Animal Foods. Land animals available for food also appear to have been severely limited in number and kind. Catalina does have a species of deer, but from the animal bones in the Little Harbor site this could not have been of more than casual occurrence in the diet. Other land animals include ground squirrels and the small island fox. There are no rabbits. Such animals as cattle, pigs, goats, and bison, all of which are now present, represent Caucasian introduction and could have played no part in the Indian economy. Various species of marine birds and migratory waterfowl must have been available seasonally. However, the island has little marshy habitat to attract ducks and geese, and there is relatively limited evidence of bird utilization in the faunal remains from the site. Quail are abundant on the island today and were probably utilized aboriginally.

There is no doubt that the major resources for the Little Harbor inhabitants did not come from the island itself, but rather from the marine resources along the shore line. Fish, shellfish, and sea mammals were the dietary staples.

The following techniques were used to gain qualitative and quantitative data.

For animal and fish bones, an attempt was made to secure a total sample from the excavation. Although the midden was not screened, the diggers were instructed to save all fragments of bone, whether or not the fragments appeared to be identifiable. Since the digging was all trowel work, done slowly and carefully, a close approximation to a total sample was obtained. The sample comprises over 6000 bone fragments (Table 4).

For shellfish remains, column samples were taken according to the techniques discussed by Treganza and Cook (1948) and Greengo (1951). The midden samples included 11 units of 2000 grams each; these were washed and sorted into component parts, then tabulated by weight. According to Treganza and Cook (1948: 292), 15 samples or more should be taken for maximum accuracy, hence our results cannot be expected to be exactly correct. However, the Little Harbor site contained such a high percentage of shell that even 11 samples gave a considerable bulk of identifiable material, and it is felt that the figures derived are a reasonable approximation to the constituents of the midden as a whole.

Once the shell species were identified (Table 5), a measure of the total food represented was estimated, using the method of Cook and Treganza (1950: 245). The midden samples also provided two other important bits of information, the first being that the site contains a great number of very small fish bones which were not recovered in the field sample. Our figures for fish consumption must therefore be increased to take into account a quantity of small fish. The other factor of interest is that the column samples provide a rough index of the intensity of occupation and hence an estimate of the population. In the development of a midden, the two major components are the food refuse and the soil, ash, and rock which accumulated at the same time. The relative proportions of these components should be significant. If the site was visited intermittently by small groups of casual gatherers, one would expect that the amount of residue in the site would be fairly great, since the food remains would tend to be more scattered and there would be time between visits for soil to be washed or blown into the site area. On the other hand, a heavier population intensively exploiting the environment would pile up food debris at a faster rate and the relative amount of soil and other residue would be considerably less. Although present knowledge does not permit quantification of these observations, they are nonetheless significant in examining shell midden remains. For the Little Harbor site there is no doubt that food refuse was accumulating at a rapid rate and that the environment was being intensively and efficiently exploited by the inhabitants of the site. One midden sample contains one of the highest proportions of shell by weight (58%) that has been recorded in California. (A shell midden containing more than 30% shell by weight gives a visual appearance of being almost pure shell.)

Of 4037 mammal bones and fragments, 536 were identified to zoological family; the remainder appeared to be the same kinds of animals (judging from size, color, and texture of pieces) but the bone was so fragmented it could not be identified. The identified bones are 81% cetacea (dolphins and porpoises), 16% pinnipeds (seals), and the remaining 3% represent land mammals (Tables 3 and 4).

In identifying the bone fragments, it was impossible to obtain osteological material for several species necessary to make complete comparisons. Collections were examined at the Vertebrate Museum of the Zoology Department, University of California at Los Angeles; the Museum of Vertebrate Zoology, University of California at Berkeley; and the Los Angeles County Museum. Comments on the identifications, prepared by Joan Seibert, are as follows:

TABLE 3. MAMMALS PRESENT IN LITTLE HARBOR COLLECTION

Cetacea
Delphinus bairdii
Lissodelphis borealis
also a larger species, a whale 30 to 40 feet long
Pinnipedia
Otariidae, seals, see comments in text
Phocidae, three questionable fragments
Carnivora
Enhydra lutris, sea otter
Felis concolor, (?) mountain lion
Urocyon (cf. *littoralis*), island fox
Artiodactyla
Odocoileus, deer

From the identifiable cetacea material at least 20 individuals are represented, based on the number of ulnas present. Most of the cetacea are easily classified to the family Delphinidae, as the size range of the animals (from 4 to 10 feet long) could only fit this family which includes the dolphins and porpoises. There are at least two genera of Delphinidae present, *Delphinus bairdii* and *Lissodelphis borealis*. However, complete identification to genus will not be possible until a specimen of *Tursiops gilli*, a common genus along the California coast, can be studied for comparative purposes.

About 26 individuals are represented in the Pinnipedia, almost all the bones being of the family Otariidae, with the possible exception of three fragments which may be Phocidae. Classification to genus is most difficult with the Otariidae, for the bulk of the material appears to be an almost extinct genus of *Arctocephalus* (or *Arctophoca*) which, with the exception of a few skulls, does not seem to be represented in any accessible osteological study collection, making positive identification of this genus impossible at present.

The cultural inferences from this bone collection are of great significance in understanding southern California prehistory. Considering the age of the site, it is surprising to find not only a heavy dependence on sea mammals, but a specialized maritime economy which exploited dolphins and porpoises to a great extent. It has been felt for some time that southern California's oldest inhabitants were land-oriented seed-gatherers participating in the generalized Desert culture characteristic of the early periods in the Southwest and the Great Basin. This is demonstrated by such sites as Topanga (Treganza and Malamud 1950) and Zuma Creek (Peck 1955). Although the Zuma Creek site overlooks the beach, it produced quantities of grinding implements and relatively little evidence of marine resources. I previously believed that true maritime cultures were not present in southern California prior to the beginning of the Christian era, but the Little Harbor site shows that well-

TABLE 4. DISTRIBUTION OF OSTEOLOGICAL MATERIAL FROM LITTLE HARBOR INTO ORDERS AND FAMILIES

BONE	ARTIODACTYLA	CARNIVORA			PINNIPEDIA		CETACEA
	Cervidae	*Felidae*	*Mustelidae*	*Canidae*	*Phocidae*	*Otariidae*	*Delphinidae*
Skull fragments			2			1	
Mandible				2	3(?)	2(?)	
Cervical vertebrae	1					1	3
Lumbar/thoracic vertebrae		2(?)			?	11	89
Caudal vertebrae					?	3	210
Manubrium	1(?)				?	23	16
Scapula					?	1	12
Humerus	1		1			9	25
Radius	1					6	30
Ulna	1					2	41
Femur						9	
Fibula	1					1	
Auditory bones							5
Pelvis			3	1		5	
Astragulus or calcis	1					10	
Totals	7	2	6	3	3	84	431
Grand Total							536

developed maritime peoples were in this region at least 4000 years ago.

It is worth noting that porpoises and dolphins cannot be obtained in any numbers with going after them in boats. We know, of course, that the Indians had boats to reach Catalina in the first place, but getting across the channel is one thing and securing a 10-foot porpoise from a small canoe is another. Interestingly, the artifact sample gives no direct indication of cetacean hunting; this is another example of important cultural information available from the faunal remains but not from the artifacts. There are no harpoons in the collection, and it appears that the cetaceans were hunted with spearthrowers. If this is so, it is clear that the people had developed great skill as boatsmen and marksmen.

Larger whales, up to 40 feet long, are represented by several vertebral epiphyses and by several dozen fist-sized pieces of spongy whale bone. No identification of species could be made from these fragments. It is difficult to conceive of the Little Harbor occupants hunting animals of this size, and the bones found may come from stranded whales. On the other hand, deliberate hunting cannot be ruled out, particularly if the hunters had knowledge of aconite or similar lethal poisons which would not be represented in an archaeological collection.

The bones of *Delphinus* and *Lissodelphis* are mostly vertebrae. However, since each animal has about 66 vertebrae, absent or rudimentary rear limbs and relatively small front limbs, a predominance of vertebrae is to be expected. Skull and jaw fragments are relatively rare; the animals were apparently cut up and all parts transported to the village except the head. It is possible that the cetacean mandibles were used as artifacts in some way; those in the site usually have all the teeth removed.

The hunting of seals on the beaches is confirmed by Seibert's observation that the bones are almost exclusively female. Presence of the infant bones indicates occupation of the site during summer or early fall, although the small number of infants does not indicate systematic hunting during the breeding season. The relatively small number of seals in the bone sample suggests that few of the animals came ashore on Catalina, a situation that also prevails today.

The fish and bird bones from the site still await detailed study. Birds were of small importance to the aborigines (275 total bones) but fish were a major part of the diet (1883 total bones, with large quantities of additional small bones appearing in the midden samples). Fish species appear varied from superficial study of the collection, ranging from small forms to many examples in the eight to 15 pound range. The only species identified thus far include white sea bass (*Cynosion nobilis*, recognized from auditory balance bones); California sheepshead (*Pimelometopon pulchrum*, recognized from the distinctive jaws, of which 45 were found); and at least two species of ray (49 jaw fragments found).

The shellfish resources in the site are predominantly *Mytilus* (mussel) and *Haliotis* (abalone). A list of species present in the site is in Table 5. Detailed information on the column samples will be published elsewhere; it is sufficient to note here that the column samples show a four to one predominance of *Haliotis* over *Mytilus* in the lower levels and a shift to the reverse situation (one *Haliotis* to four *Mytilus* by weight) in the top levels. There is no reason to postulate any environmental change as explanation for this shift. It is most likely due to over-exploitation of the favored shellfish species to the point of very serious depletion. When the inhabitants reached the point where nearly all of their shellfish food was mussel, the site was abandoned and never reoccupied. Presumably the people moved on to a more favorable location.

There is considerable theoretical significance to this picture of over exploitation in view of the opinion sometimes expressed that primitive man was in a sort of balance with his environment.

TABLE 5. SHELL SPECIES IN LITTLE HARBOR SITE

Starred species (*) are the common ones and are present in the column samples from the site. All the other species are from field samples only and are relatively rare, from one to several individual shells having been recorded.

**Acmaea* sp.	*Olivella biplicata*
**Astraea undosa*	*Plagioctenium circularis*
**Balanus* sp. (common)	*Polinices lewisii*
**Balanus glandula*	*Pseudochama exogyra*
Cerithidea californica	*Pusula solandri*
**Chiton* sp.	**Septifer* sp.
Conus californicus	*Tivela stultorum*
**Haliotis corrugata*	
**Haliotis cracherodii*	*Sea urchin (*Strongylocentrus*)
**Haliotis fulgens*	*Tube worm (*Aletes?*)
Lottia gigantea	
Maxwellia gemma	*Land snail
Megathura crenulata	
**Mytilus californianus*	Crab claw
Norrisia norrisii	

This example shows that in at least some cases primitive man worked his environment for all it would yield of a favored resource, ignoring less desirable foods until forced to utilize them.

The total meat resources represented in the Little Harbor midden are indicated in Table 6. The indications are that the 26 cubic yards of excavated midden represent over 5000 kilograms (11,000 pounds) of meat, about half being shellfish and the other half sea mammals and fish. Apparently the aboriginal inhabitants lived on a meat diet not unlike that of the modern Eskimo in its "high protein" nature.

It is tempting to hypothesize a division of labor in the hunting and collecting activities, with the women providing the shellfish and the men doing the fishing and hunting of sea mammals. However, although this seems logical there is no tangible archaeological evidence for it.

COMPARISONS AND CONCLUSIONS

A comparison of the 34 categories of Little Harbor artifacts with those from other Californian sites shows that the greatest number of similarities, 19 traits, is shared with Early central California sites near Sacramento. Put another

TABLE 6. MEAT RESOURCES REPRESENTED IN LITTLE HARBOR SITE

TYPE OF EVIDENCE	11 COLUMN SAMPLES	TOTAL SITE	FLESH WEIGHT*	FLESH WEIGHT*
	(1232 Cubic Inches) Actual Kilograms of Bone and Shell	*(720 Cubic Yards) Kilograms of Bone and Shell (Projected from Column Samples)*	*In Kilograms Represented by 1 Cubic Yard of Midden (Projected from Column Samples)†*	*In Kilograms for Total Site, (Projected from Column Samples)‡*
Shell				
Mytilus	3.666	92,738	55.22	39,758
Haliotis	3.063	78,070	28.53	20,542
All other shell	0.733	18,683	8.65	6,228
Bone				
Fish, mammal, and bird	0.197	4,921	139.47	98,423

* Calculations of meat weight were derived from the following sources:

Mytilus — Cook and Treganza 1950: 250, shell weight to flesh weight, 2.35 to 1.

Haliotis — Bonnot 1948: 165, commercial trimmed weight, shell to flesh, 3.80 to 1.

Bone — Cook and Treganza 1950: 245, bone weight to flesh weight, 1 to 20.

† The projection of figures to a single cubic yard of midden is done in an effort to provide a comparative standard for future studies. It is hazardous to use the figures for the total site because of the difficulty of accurately calculating site volume when only a small part of the site is dug. Irregularities in submidden soil (as at Little Harbor) may make estimates of site volume completely unreliable. Cook and Treganza (1950, Table 4) give the percentage of bone by weight, but it is difficult to visualize the available meat resources from these figures. For Little Harbor, the percentage of bone by weight is 0.895, a higher figure than for any of the 20 sites tabulated by Cook and Treganza.

‡ An attempt was made to estimate the flesh weight by figuring the number of animals present in the 26 cubic yard excavation sample, totaling a "guess weight" of such animals. Only the roughest kind of estimation can be made, but it yields an answer not too dissimilar from the calculations based on the column samples. The estimation includes the following: 20 cetacea, averaging perhaps 100 kilograms each — 2000 kg.; 26 pinnipeds, averaging perhaps 30 kilograms each — 780 kg.; 1 deer — 30 kg.; 100 medium to large fish, probably about 3 kilograms each — 300 kg.; perhaps 20 kilograms of bird flesh — 20 kg.; total — 3130 kg. This is based on 26 cubic yards of midden, giving a figure of 120 kilograms of edible animal flesh per cubic yard. This is close to the figure of 139 kilograms per cubic yard figured from the weight of bone in the column samples. Since there are quite different sources of error in the two methods of calculating flesh weight, the consistency of the answers is encouraging. The other possible genera present, *Zalophus*, *Eumetopias*, and *Callorhinus*, are too similar anatomically to justify positive identification of the bone fragments at hand.

With perhaps four exceptions, all of the pinnipeds seem to be adult females. The exceptions are three infant femora and a questionable male ilium. It has been suggested (Lyon 1937) that the predominance of female seals in southern California sites may be due either to raiding of the rookeries and hauling grounds, or to the fact that in some species (such as *Callorhinus*) only the females migrated to this area after breeding elsewhere. The apparent prevalence of *Arctocephalus* could be explained, as Lyon again suggests, by the tendency of this form to remain about the rookery grounds during a large part of the year, in contrast to the lengthy migrations of the northern fur seals. However, in an archaeological situation other factors concerning the human inhabitants as well as the animal should be considered in explaining the dominance of one order or genus over another.

The artiodactyl specimens have been identified as *Odocoileus* (deer). Since there is probably not more than one individual represented the order must have been quite rare and the single animal in the collection might even represent food brought from the mainland.

The family Felidae seems also to be represented by two vertebrae from the thoracic region of *Felis concolor* (mountain lion); if the identification is correct, this may also be derived from the mainland. At least two individuals of *Enhydra lutris* (sea otter) are present, as identified from pelvis, skull, and humerus fragments. Two mandible fragments and a pelvis of the family Canidae, genus *Urocyon*, were also recognized. The species is most likely the small channel island fox, *Urocyon littoralis*.

I am indebted for suggestions and verification of identifications to Frank Peabody, University of California at Los Angeles; Ted Downs, Los Angeles County Museum, and Seth Benson and R. A. Stirton of the University of California at Berkeley.

way it can be said that Little Harbor shares 56% of its artifact types with Early central California. These two collections both have radiocarbon dates close to 4000 years ago, and the similarities might suggest close cultural connections between the cultures in question. Actually, this would be an erroneous conclusion; the quantitative distribution of the artifacts is quite different, the whole ecological pattern is different, and there is no particular reason to believe that any direct contact through trade or visiting ever took place between the two regions (which are some 400 miles apart). The only reliable conclusion is that the two regions shared a common and relatively simple technological tradition.

This sharing of a simple technology is further demonstrated by the comparison of Little Harbor and such cultures as Canaliño and San Luis Rey I. Although both of these cultures are presumably quite a bit later in time than Little Harbor, there are a fair number of resemblances. At least some of the Little Harbor artifacts (bone fish gorgets, perforated stones, quartz crystals, spire-lopped shell beads, tarring pebbles, bird-bone tubes and awls) are also found in protohistoric and historic sites, indicating their use through at least four millennia. It is apparent that in a region of simple technology and slow change, real understanding of cultural development and cultural relationships cannot be obtained from study of artifacts alone, nor from trait-list comparisons. Only an environmental-functional study which considers the available nonartifactual evidence can provide a basis for systematizing the many variants of the simpler cultures. Thus, a comparison of the artifact assemblage from Little Harbor with 20 other artifact assemblages described for California yields no particular understanding of Little Harbor beyond placing it in the "Californian" pattern. The distinctive features of the Little Harbor culture, its maritime adaptations, are only dimly reflected in a mere artifact inventory.

In studying more complex developments, the so-called civilizations, with their relatively rapid stylistic changes, more complex technology, and elaborated art traditions, it is possible to gain a good understanding of the culture through the artifacts alone. But the techniques of study used by the classical archaeologists (and some of the "high culture" specialists of the New World) are not sufficient for simpler remains, and such remains may appear meaningless to one trained in the humanities or art history. One can with profit study the culture of ancient Egypt from the point of view of the humanities; indeed, it is essential to consider this view. On the other hand, when we turn to the generalized "archaic" cultures we must shift to the natural sciences to attain understanding of the processes involved. Just as man began as an animal in the biological world and became a creature of culture, so the archaeological record of his activities reflects a shift from "man in nature," whose main preoccupation was with his environment, to the modern situation where much of human energy can be diverted from concern with nature (so much, in fact, as to be seriously disturbing to conservationists as well as some philosophers and poets). Thus, the study of archaeology may be seen as largely a natural science when dealing with the earliest or simplest technological levels, whereas as cultures become more complex, the archaeologist may utilize more and more of the techniques of the humanities.

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BASKETMAKER FLUTES FROM THE PRAYER ROCK DISTRICT, ARIZONA

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IN THE summer of 1930, Earl H. Morris accompanied the Bernheimer Expedition in its exploration of the archaeological remains on the slopes of Carrizo Mountain and the north end of the Lukachukai range in northeastern Arizona. Three weeks were spent in the Prayer Rock district on the east side of these mountains (Bernheimer 1930). Morris was intrigued by the possibility of collecting Basketmaker materials from an area so rich in early cave sites; he returned to the Prayer Rock district in 1931 under the auspices of the Carnegie Institution of Washington. A portion of the materials recovered in this season has been described (Morris 1936, 1951; Morris and Burgh 1941) and a series of reports is in preparation on the remainder of the specimens. This paper describes seven flutes found in these excavations. The Prayer Rock valley is located between Carrizo Mountain and the north end of the Lukachukai range (Fig. 1). It is on the east side of the forested divide which connects the mountain masses and separates the drainage of the Chinle from that of the Red Wash which flows north into the San Juan River. The Prayer Rock itself is a tall monolith of red sandstone which towers above the valley. Several tributaries of the Red Wash drain the Prayer Rock valley. One of them, called Atahonez by the Navajo, contains more than a dozen prehistoric cave sites. Most of these rock shelters exhibit an intensive Basketmaker occupation partially overlain by a thin veneer of later material. Morris named one of the largest of these rock shelters Broken Flute Cave when he found one of the fragmentary specimens described in this paper. This cave produced six of the seven flutes. An incomplete one came from Obelisk Cave in a neighboring valley although the observable characteristics of this flute differ in no way from those of the other specimens. A little fired pottery was found in Obelisk Cave but the nine tree-ring dates, which fall between A.D. 470 and 488 (Smiley 1951: 24), are somewhat earlier than those from the other caves.

Broken Flute Cave contained 16 pithouses and 65 cists dating from the Basketmaker III period. The tree-ring dates range from A.D. 490 to 800, with 55 of the 67 specimens dating between 621 and 630. The dwellings were shallow rectanguloid structures with plastered floors and fire basins. At least one had a roof entry and several had indications of side entries. The roofs were primarily supported by four main posts; a number of vertical secondary timbers were included at intervals in the walls. The predominant pottery types found in the cave were Lino Gray, Obelisk Gray, and a few pieces of Basketmaker III Black-on-gray (Colton 1955). In apparent association with these were several shallow unfired bowls with basket impressions on the exterior surfaces. A detailed ceramic study will be included in the main report now in preparation.

Two flutes were found intact, cached beneath the floor of a house. Morris states in his field notes:

> At the west end of the south wall of Room 4, a slot had been gouged in the floor, its western end extending back under a natural stone in place at the base of the room wall. In this cavity not more than 5 cm. below the floor, were hidden two wooden flutes tied together with strips of yucca. The mouth ends lay toward the east. One of them was stopped at each end with wads of yucca fiber, the other was plugged at one extremity with a corn cob. Enclosing the end farthest distant from the player there was a wad of yucca fiber, placed there to protect the feather ornamentation bound to cover a certain portion of each flute.

Around the proximal ends of these flutes strips of bird skin were tied with yucca fiber cord (Figs. 2, 3 *a*, *b*). A species identification was made by J. T. Marshall of the Department of Zoology, University of Arizona. There were feathers from nine stellar jays (*Cyanocitta stelleri*), six red-shafted flickers (*Colaptes cafer.*), one pinyon jay (*Cyanocephalus cyanocephalus*) and three or four red-naped sapsuckers (*Sphyrapicus varius nuchalis*). These birds live in pinyon and ponderosa pine forests such as are in the immediate vicinity of the caves today. The red, blue, and black feathers must have been highly valued in a time when brightly colored things were rare. Two other flutes were broken and scattered in the trash above a burial cist. All of the pieces were recovered and the specimens restored to their original form by Earl Morris. One of these had shallow scorings in the wood, radiating out from five of the six holes. These were probably an attempt at decoration and possibly represent a desire to roughen the wood around the holes to prevent slippage of the fingers. The two remaining flutes from this cave were so fragmen-

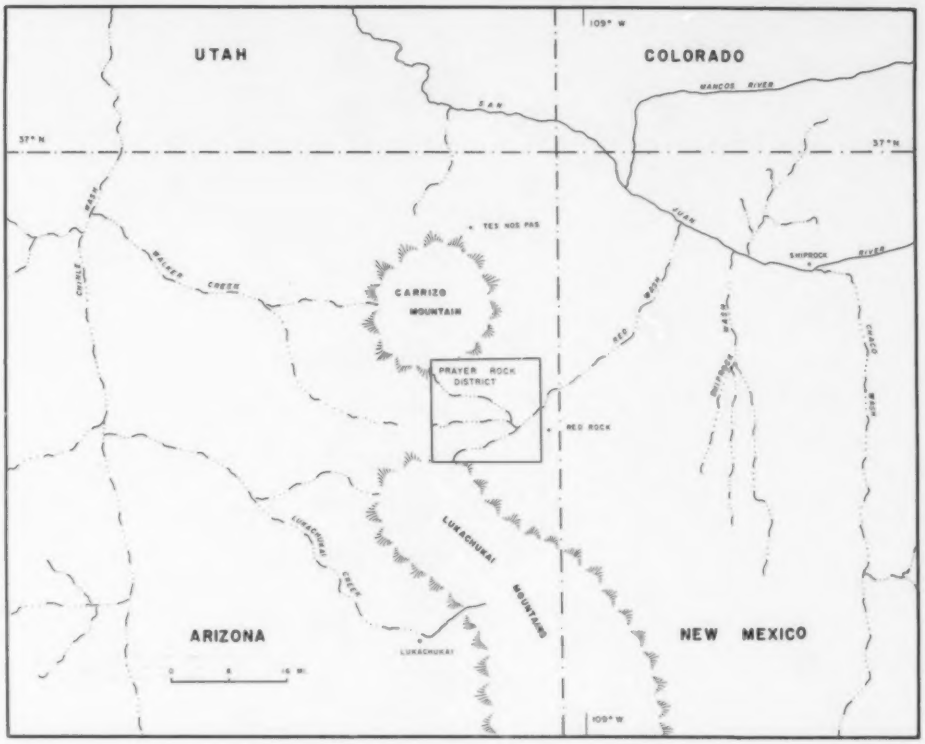

FIG. 1. Map of the Prayer Rock District in Northeastern Arizona.

tary that only a few observations could be made on them. Each was found scattered through the trash filling a cist.

All of the flutes are remarkably similar in nature except for the decorative techniques described above. The wood was identified by the U. S. Department of Agriculture Forest Products Laboratory in Madison, Wisconsin, as boxelder (*Acer negundo*). Trees of this species were observed growing in the valley bottoms by the Bernheimer Expedition in 1930. The instruments are long, uniformly constructed tubes. The length of the four complete specimens (Fig. 3) varies between 68.5 and 74.1 cm., and the outside diameter between 2.4 and 2.6 cm. The exterior surfaces of the barrels are highly polished. The hollowing out of the cylindrical bore reflects extremely skillful manufacturing techniques. The walls of the flute barrels vary between 3 and 5 mm. in thickness. The interiors are smooth and even, and must represent some closely controlled process of drilling. This would have been facilitated by the presence of a large corky pith in elder wood.

The proximal end, the one determined to have been the mouthpiece, has a slight outside taper. The distal end is cut squarely across. Apparently Morris was in error in his original identification of the end without the feathers as the mouthpiece. Both ends of one flute are wrapped with sinew, presumably to keep the wood from splitting. The inside of the proximal end has been smeared with pitch, probably for the same purpose. Marks on the proximal end of another flute show where similar wrappings were present at one time. It would be expected that splitting and cracking would be more of a problem at the mouthpiece end of these instruments where moisture would accumulate. As Morris stated in his field notes, each end of one of the cached flutes was plugged with a wad of yucca fiber and one end of the other flute was filled with a corn cob. It is suspected that these were in place to keep foreign material from

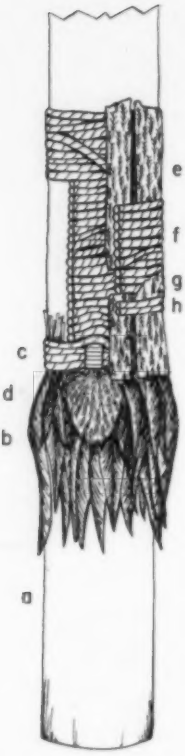

FIG. 2. Detail of feather decoration on one flute (Fig. 3 *b*). Sequence of attachment indicated by letters. *a*, barrel of flute; *b*, black crowns of stellar jays; *c*, *f*, *h*, yucca fiber string; *d*, light blue breast feathers of pinyon jay; *e*, *g*, strips of skin with red feathers of red-naped sapsucker crowns and red shafted flicker heads.

entering the barrels of the flutes when they were not in use.

The holes are nearly identical in size, method of formation, and position. They occur in two groups of three holes each near the distal ends of the instruments. The three holes within a group are from 4 to 4.2 cm. apart and the two groups are from 8.9 to 10 cm. apart. The last hole in the distal group lies between 10.8 and 12.6 cm. from the squared end. The first hole in the proximal group is from 31.9 to 36.3 cm. from the tapered end. All holes vary between 6 and 8 mm. in diameter. They were presumably formed by cutting or drilling a hole through the barrel wall. They were then enlarged by some instrument which undercut the surface and produced a smoothed double-beveled edge on the hole. The flutes were made to fit relatively exact standards.

The presence of these well-defined specifications is an indication of a precise recognition of desired notes and an ideal scale on the part of the manufacturers. With the assistance of B. M. Bakkegard of the Department of Music, University of Arizona, notes were played on one flute (Fig. 3 *b*) and a tonal analysis made. The sounds were not unlike those produced on modern flutes and had considerably more richness and depth than many of those available in ethnographic recordings. It was interesting to note that the bird feathers were ruffled by the breath of the player, adding a visual counterpart to the music itself. Evidence as to the position of the flute when it was being played lies in the position of the worn areas around the finger holes on one well-used specimen (Fig. 3 c), and the worn places on the lower side of the proximal ends of all of the instruments. Music was played by directing a stream of air against and across the half of the proximal end farthest from the player. In effect this directed the stream of air into the barrel of the flute through a restricted aperture, serving a function similar to the mouthpiece of modern instruments of this general type. The open flute with no finger holes closed produces the note a^1. Continuing down the instrument, starting from the proximal end and closing each hole in turn, g^1, f^1, d^1, c^1 sharp, c^1, and b flat, are sounded. The first five notes a^1, g^1, f^1, d^1, c^1, comprise the pentatonic scale in musical notation. The addition of two more holes indicates that the music of the players of these flutes called for a greater range of notes. Through alternate fingering a greater variety of notes is possible, and as is characteristic of modern instruments the octave may be overblown. The players of these flutes were potentially capable of producing music of great complexity and beauty.

Other flutes of this type are reported from Southwestern sites. The entire class may be distinguished from smaller flutes and whistles made from sections of reed or cane on the basis of manufacture, size, and possibly distribution. Specimens of the cane type are reported from Ventana Cave (Haury 1950: 425), Tularosa Cave (Martin and others 1952: 357), the Canyon Creek ruin (Haury 1934: 114), and from two caves on the upper Gila River (Cosgrove 1947: 120). Several are in the American Museum of Natural History. Kidder and Guernsey (1919: 186) report one from northeastern Arizona, and

one specimen is present in the collections from the Prayer Rock district. Two flutes are reported from Gypsum Cave (Harrington 1933: 149). Both specimens are made of elder and are about 1.2 cm. in diameter. One is 60 cm. long and has four holes placed about 5 cm. apart. The other is 25.5 cm. long and has six holes averaging about 2.5 cm. apart. These flutes may represent the same tradition as the instruments described here, but their age and cultural affiliations are uncertain.

Instruments similar to the Prayer Rock Basketmaker flutes have been found elsewhere on the Colorado Plateau. A Basketmaker burial in Tsea-hotso (Big Cave) in Canyon del Muerto contained four flutes which are now in the University of Colorado Museum. A nearby burial of the same period yielded a flute encrusted with white beads set in pitch (Morris 1925: 264, 293). Two of the four flutes resemble the Prayer Rock instruments in every detail, except for the species of wood and the fact that there are only two holes in the proximal group of one of them. All four are made from *Pranus* sp., probably chokecherry, which like boxelder has a large soft pith that could easily be removed. The other two flutes are 94 and 97 cm. long, and about 3.1 cm. in diameter with a wall thickness of 3 and 4 mm. They have four holes, about 1 cm. in diameter, located in two groups of two. The last hole in the distal group is 19.5 and 21.1 cm. from the distal end. The first hole in the proximal group is 44 and 45.6 cm. from the proximal end. Holes within a group range from 9.2 to 9.6 cm. apart; the groups are 10 and 12.2 cm. apart. One flute has parallel incised zigzag lines along the barrel at the distal end. This specimen had sinew wrappings at intervals along its entire length. The other long flute was wrapped with sinew at one end. Amsden (1949: 134) is probably describing this collection when he mentions Basketmaker flutes with four, five, and six holes. The occurrence of two distinct but associated types of flutes suggests a diversified musical tradition in Basketmaker III times.

Nordenskiöld (1898: 101) pictures two fragments of a Pueblo III flute from Spring House at Mesa Verde. One piece has a group of three

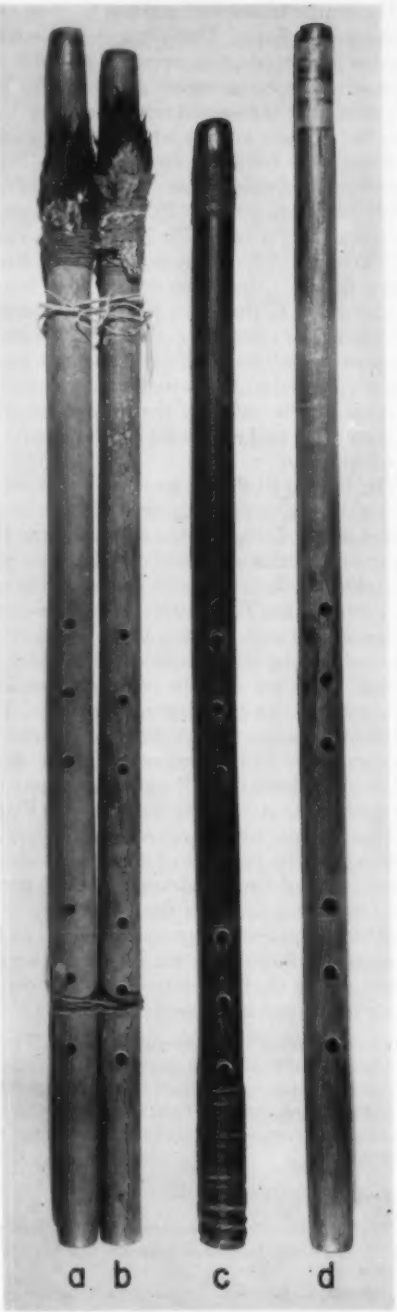

FIG. 3. Four flutes from Basketmaker III caves in the Prayer Rock district. Musical notes were produced by blowing through end farthest from upper finger holes. Note indications of wear around finger holes in *c*. Length of *a*, 74.1 cm.

holes, similar in size and position to those of the Basketmaker flutes. The other piece contains a portion of one hole, indicating the probable presence of a second group of holes in this flute. Another flute is reported from the Mesa Verde area but no data are available on it. A number of flutes were found in Pueblo Bonito. Pepper found eight complete ones in Room 33 (Pepper 1909: 199; Judd 1954: 305), and two fragments in Room 25 (Pepper 1920: 109). These Pueblo III specimens differ from the described Basketmaker flutes: *a*, they taper slightly from one end to the other; *b*, there are four holes placed at more irregular intervals; *c*, they exhibit a greater range in over-all size, 68.7 to 105.4 cm. One was brightly painted and three had decorations carved in relief on the barrel of the flute. The others were undecorated except for the functional end wrappings.

The Pueblo III flute, like many other aspects of this culture, is probably derived from Basketmaker times. Ethnographic data from the Hopi villages of northern Arizona describe flute societies which include flutes of several varieties in their ceremonies (Titiev 1944: 147). These rituals are associated with worship of the sun and with the summer and winter solstice ceremonies. Although flutes are used in other ceremonies of these people, there is apparently no secular use of the instruments. It is possible to infer that the wooden flutes had a similar functional significance in Basketmaker III culture, inasmuch as the prehistoric cultures of the Colorado Plateau had many traits which are retained in Hopi culture today. The presence of this specialized class of precisely fashioned instruments which persists into later times indicates the importance of the music to the people who played them. The Basketmaker III flutes from the Prayer Rock valley demonstrate that this musical tradition was firmly implanted in Anasazi culture by A.D. 700.

Acknowledgment. I am grateful to Joe Ben Wheat of the University of Colorado Museum, Phillip C. Gifford of the American Museum of Natural History, and Jean Pinkley at Mesa Verde National Park, for providing information about the flutes which are in the collections of these institutions.

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UNIVERSITY OF ARIZONA
Tucson, Ariz.
March, 1958

THE MOFFATT ARCHAEOLOGICAL COLLECTION FROM THE DUBAWNT COUNTRY, CANADA

ELMER HARP, JR.

ON JULY 3, 1955, six men in three canoes shoved out into Black Lake, Saskatchewan, and began a long journey northward toward the great Barren Grounds. The party consisted of Peter Franck of Woodside, California; George Grinnell of New York City; J. Edward Lanouette of São Paulo, Brazil; Bruce LeFavour of Amsterdam, New York; Fred Pessl, Jr., of Grosse Pointe Woods, Michigan; and the leader and organizer of the expedition, Arthur R. Moffatt of Norwich, Vermont. The purpose of their venture was to make a documentary film of canoe travel through a portion of the North American boreal forest and tundra zone and to obtain a pictorial record of both the wild life and any aboriginal peoples that they might encounter. Also, they planned to collect archaeological materials along their route. The ultimate destination of the Moffatt party was Baker Lake (Fig. 1), or, if they had sufficient time, the mouth of Chesterfield Inlet. According to known reports, they would be the first to traverse that entire distance by canoe since the geologist J. B. Tyrrell (1898) first explored the route in 1893. From Black Lake their trail led up the Chipman River to Bompas Lake and thence to Selwyn Lake. On July 17 they passed over the height of land to Wholdaia Lake and the drainage of the Dubawnt. As they progressed northward through Boyd, Barlow, Dubawnt, and Wharton lakes, most of their plans and expectations were fully realized, but toward the end of August they were beset by increasingly bad weather. Rain, snow, and cold hampered and delayed them seriously on the Barren Grounds, and on September 14, while still 200 miles short of their minimum goal, they met disaster.

In shooting rapids above Marjorie Lake two of the three canoes capsized, and in the ensuing confusion Moffatt and Lanouette, who had been in the lead craft and were first to go under, suffered prolonged immersion in the icy water. They were finally aided to the shore of an island, but shortly thereafter Moffatt succumbed and the party was bereft of its leader. The remaining members of the group, under Pessl's able guidance, salvaged what they could of the soaked equipment and supplies, although much had been lost in the turbulent stream. In freezing temperature they spent a day attempting to dry out clothing and sleeping bags, built a cache and a grave, and then moved on. Ten days later they came out of the Thelon River to the Baker Lake Post and radioed their news back home. Those of us who were Moffatt's friends are diminished and still saddened by his untimely loss.

Mrs. Moffatt turned over to me the small archaeological collection gathered along the route by members of the expedition, and graciously lent me her husband's Journal for the light it might shed on the various sites in which artifacts were found. I have since been further aided by George Grinnell, who checked with me in pinpointing site locations and helped to clarify the questionable associations of several specimens. Ten different sites were discovered, but only nine of these received specific mention in the Journal (Fig. 1). Furthermore, only six sites contribute to the total of 98 specimens forwarded to me. Two of these specimens are of unknown provenience, and I do not know what may have happened to any artifacts obtained in the three sites which have no representation in the collection. In every case the materials were gathered by surface hunting only, and no excavation was undertaken at any of the sites. The report which follows is based on my study of such limited data. It is brief, and in many ways incomplete, for these men were not trained in the techniques of modern archaeology. Nevertheless, I believe the Moffatt collection makes a significant contribution to our knowledge of Arctic prehistory. As far as I know, it is the first material of its kind to be brought out of that remote region, and it furnishes us with at least a glimpse of the culture of the early men who exploited that forbidding environment.

THE SITES AND THEIR INVENTORIES

Site 1, Chipman River

Excerpt from Moffatt's Journal, July 10:

> We crossed the first 3 chain portage toward Bompas Lake where we camped. . . . and paddled slowly up to the 44 chain portage on the right. . . . The first part was up a steep hill, where Joe Lanouette found his second artifact — a piece of chipped chert, and where there were a lot of pieces of chipped white quartz. . . . This was the moraine that blocks the valley, mentioned by Tyrrell. [See Tyrrell

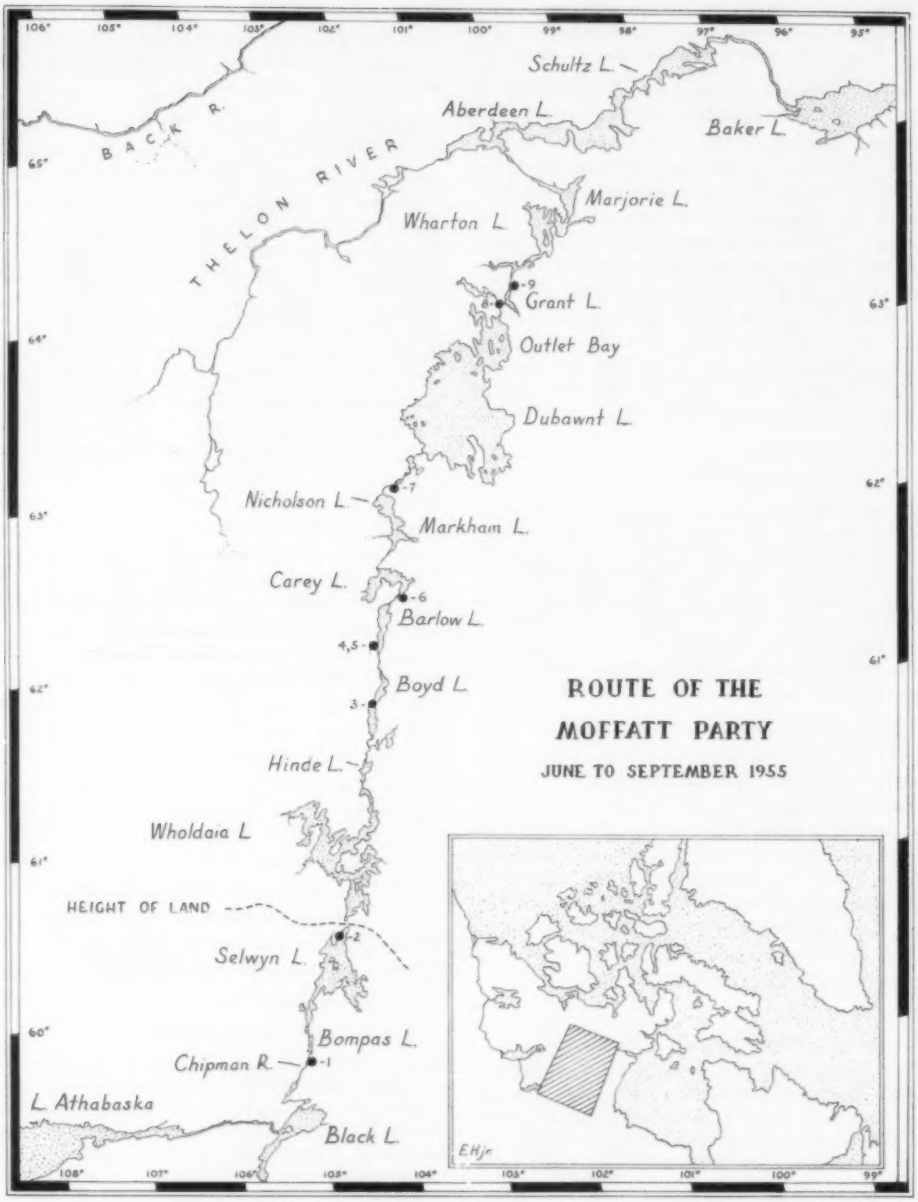

FIG. 1. Map of the Dubawnt country, N.W.T., Canada, showing the location of the archaeological sites visited by the Moffatt party.

(1898: 39 F, and endmap of that paper). The Journal contains no mention of any other site where Lanouette earlier picked up his first artifact, hence I have numbered Chipman River as the first of nine sites that are recorded.]

Approximate location of Site 1: 59°33′30″ N by 105°01′30″ W (Black Lake, Sheet 74 NE, Preliminary Edition, 1949). This location, and all others that follow, have been determined on the 1:506,880 maps of the National Topographic Series of Canada, Department of Mines and Technical Surveys, Surveys and Mapping Branch, Ottawa. There are two specimens from this site, one of which is illustrated (Fig. 2 *a*). It is the basal fragment of a white quartzite point with bifacial chipping, biconvex section, base thinned by longitudinal flaking on one face, and lateral edges smoothed. The other specimen is a modified but unidentifiable chip of flint.

Site 2, Selwyn Lake

Excerpt from Moffatt's Journal, July 16:

The route was easily made out from the map, and if we had not stopped to photograph an Indian grave on a sand point opposite to some islands at the entrance to the NE arm of the lake, we would have been at the portage early in the afternoon. However, that stop was valuable, for we found our first recognizable arrow point, and collected a good specimen — Bruce LeFavour found it. From there we paddled on, high, rocky, almost cliff-like hills hemming us in, and the height of land, blue and high ahead.

Approximate location of Site 2: 60°13′ N by 104°21′ W (Wholdaia Lake, Sheet 75 SE, Aeronautical Edition, Preliminary Edition, 1948). Grinnell indicated to me that this site was on the west side of the lake, and he also noted that the Indian grave mentioned above was "modern." Figure 2 *b* is the arrowpoint found here. It is side-notched and bifacially worked. Asymmetry and modified blunt end suggest possible use as knife. Seven other specimens from this site are all quartzite flakes or core fragments.

Site 3, Boyd Lake

Excerpt from the Journal, August 1:

. . . 3 straight hours of paddling up Boyd, all the way north across wide part to bend to east. . . . Then, somewhat lost, made camp on island — high, almost barren hill. We are 6 miles north of tree line as per Tyrrell and map, but still plenty of wood. . . .

August 2 (in same camp):

So good day — and tonight, after supper, P. Franck found small quartzite arrowhead on top of hill, probably where hunter sat to watch caribou trail — and I found fragment of orange quartzite spear point, white quartzite arrow point.

August 3 (in same camp):

Rain and cold. . . . I made breakfast. Then hunted for points where Pete had found his and I mine. Found ½ doz more certain and same number probable points. Spent rest of afternoon dodging rain. . . .

Approximate location of Site 3: 61°31′50″ N by 103°20′30″ W (Kazan River, Sheet 65 SW, Aeronautical Edition, Preliminary Edition, 1949). There are 15 specimens, all quartzite, from this site (Fig. 2 *c-l*). They include seven whole or fragmentary projectile points, three large points or blades, four large blades or scrapers, and one unmodified flake. The points include: a leaf-shaped point (Fig. 2 *c*), plano-convex in section, basally thinned, unifacially worked; a side-notched point or knife (Fig. 2 *d*), slanted base not thinned, biconvex section, bifacially worked; a side-notched point (Fig. 2 *e*), thinned base, biconvex section, crude bifacial chipping; a basal fragment of a corner-notched point (Fig. 2 *f*), thinned base, biconvex section, bifacially retouched edges; a basal fragment of a side-notched point (Fig. 2 *g*), base abruptly thinned, biconvex section. The orange quartzite spear point (Fig. 2 *h*) noted in the Journal has rough bifacial percussion flaking, lateral edges further retouched on one face, biconvex section, maximum thickness 11.5 mm. There is a crudely worked blade (Fig. 2 *i*) or unfinished blank of lanceolate shape with alternate bifacial percussion flaking, sinuous edges, and a maximum thickness of 22.3 mm. The other artifacts illustrated are: fragment of a large biface (Fig. 2 *j*) with edge retouch on one face, maximum thickness 12.9 mm.; mid-fragment of large blade (Fig. 2 *k*), bifacial percussion flaking, biconvex section, maximum thickness 11.2 mm.; basal fragment of ovate or lanceolate blade (Fig. 2 *l*), bifacial flaking, biconvex section, maximum thickness 8.7 mm.

Site 4, Barlow Lake (A)

Excerpt from Journal, August 5:

[going toward Barlow Lake] We are not yet beyond the limit of the trees—valleys and low places still have plenty in groves, but hills and ridges and meadows bare, stony, greenish with grass and creeping berry-bearing plants, and dwarf birch. Tamarack numerous, largest trees, bedrock almost nonexistent. . . .

August 6:

We made good time down the swift river—many boulders and easy rapids — caribou in groups of 3 to 10. . . . then into lake, Barlow — about 4 miles, and on into bay by 5 pm. Wind strong beyond, and I climbed a hill at point.

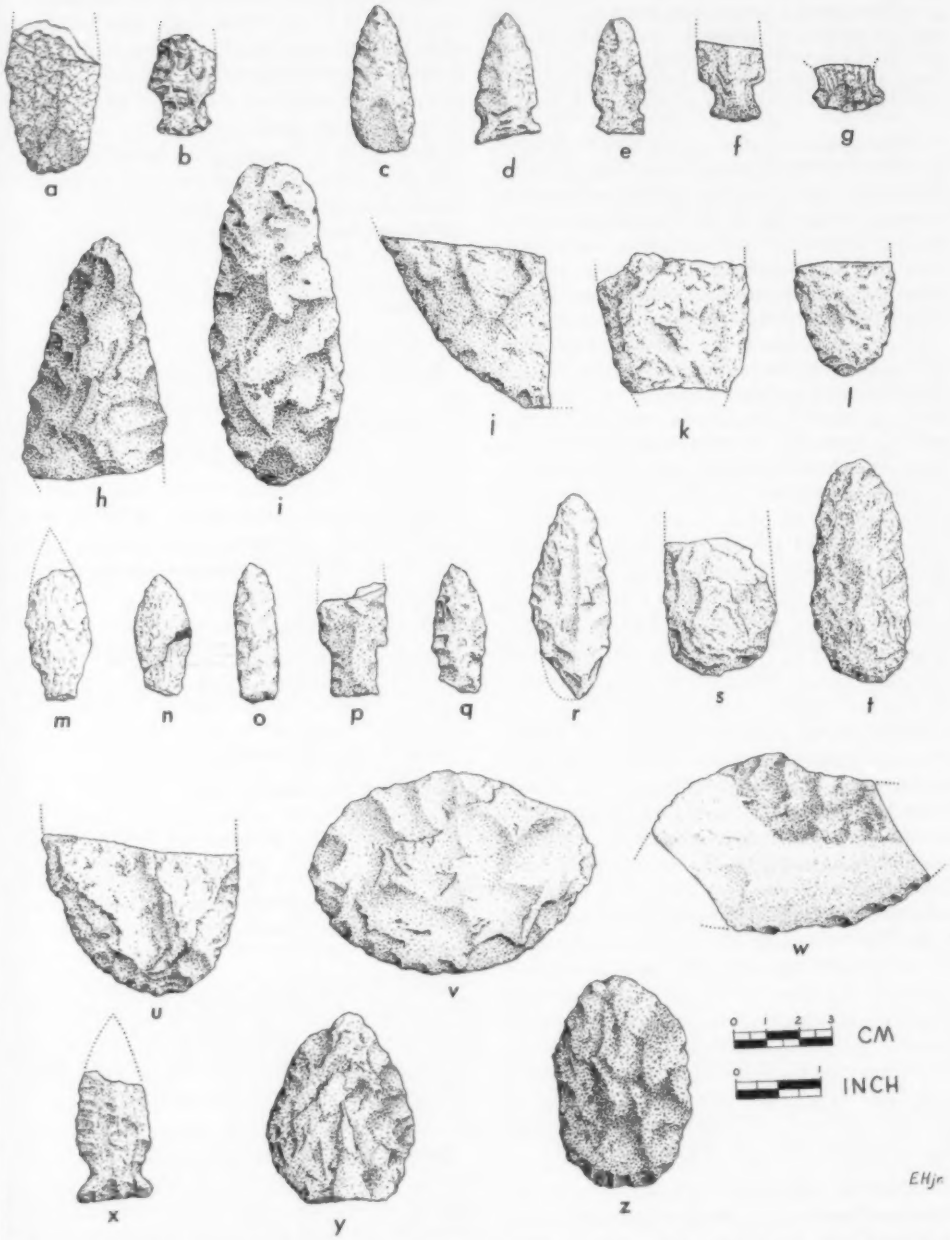

FIG. 2. Artifacts from the Moffatt Collection. *a*, Site 1, Chipman River; *b*, Site 2, Selwyn Lake; *c-l*, Site 3, Boyd Lake; *m-w*, Site 4, Barlow Lake (A); *x-z*, Site 5, Barlow Lake (B).

Almost immediately saw quantities of white quartz chips. . . . Then found a scraper, Pete found beautiful pink quartzite scraper, and tonight Joe found two points, one odd-shaped one which may be valuable. . . . [An outline sketch of this latter specimen, on page 87 of the Journal, identifies it as the one I have illustrated in Figure 2 *o*.]

Approximate location of Site 4: 61°54′50″ N by 103°03′30″ W (Kazan River, Sheet 65 SW). One of the specimen bag labels confirmed the location of this site on the "southwest side" of the lake. A total of 15 artifacts (Fig. 2 *m-w*) came from this site, including the whole or parts of seven projectile points and seven larger blades, all made of quartzite, and a lenticular abrading stone of sedimentary rock. Those illustrated are: ovate point (Fig. 2 *m*) with tapering stem, roughly flaked on both surfaces, biconvex section, maximum thickness 8.9 mm.; ovate point (Fig. 2 *n*) with tapered stem, smoothly flaked on both surfaces, plano-convex section, maximum thickness 6.7 mm.; lanceolate point (Fig. 2 *o*) with parallel sides and square base, bifacially retouched, basally thinned, biconvex section, maximum thickness 5.4 mm.; basal fragment (Fig. 2 *p*) of corner-notched, stemmed point, bifacial retouch, biconvex section, maximum thickness 6.9 mm.; ovate point (Fig. 2 *q*) with contracting stem, bifacial retouch, biconvex section, maximum thickness 7.5 mm.; lenticular point (Fig. 2 *r*), probably double ended, rough bifacial flaking, essentially plano-convex section, maximum thickness 8.2 mm.; basal fragment (Fig. 2 *s*) of ovate blade or point, rough bifacial chipping, biconvex section, maximum thickness 11.6 mm.; ovate blade or point (Fig. 2 *t*), sinuous edges and crude bifacial flaking, biconvex section, maximum thickness 12.5 mm.; fragment of large ovoid knife (Fig. 2 *u*), rough bifacial percussion flaking and secondary edge retouch, biconvex section, maximum thickness 16.4 mm.; large ovoid knife (Fig. 2 *v*), bifacially worked, sinuous edges from alternating retouch, essentially plano-convex section, maximum thickness 12.3 mm.; fragment of large knife (Fig. 2 *w*), probably ovoid, formed mainly by bifacial edge retouch of plano-convex spall or blade, maximum thickness 10.9 mm.

Site 5, Barlow Lake (B)

Excerpt from Journal, August 7 (in same camp as above):

Up at six. Skip and I went to get shots of me approaching herd of caribou. . . . Then I found an arrowhead or two on next ridge south of camp.

The location of this site is presumably very close to Site 4, and three of the four specimens that it produced are illustrated here: side-notched projectile point (Fig. 2 *x*), sinuous edged from alternating pressure retouch, biconvex section, maximum thickness 7.7 mm.; ovate point or knife (Fig. 2 *y*), percussion flaked mainly on one face, edge retouched on both faces, base square and not thinned, plano-convex section, maximum thickness 11.1 mm.; turtleback scraper (Fig. 2 *z*), percussion flaked on upper surface, maximum thickness 14.8 mm.; all made of quartzite.

Site 6, Carey Lake

Excerpt from Journal, August 7:

Ran rest of rapids to Carey Lake, camped on west side of river mouth. After supper. . . . paddled over to hill on east side of river for arrowheads — found one at once on lowest beach level.

Approximate location of site: 62°06′45″ N by 102°45′50″ W (Dubawnt Lake, Sheet 65 NW and 65 NE, 1952). The specimen from this site is missing from the collection.

Site 7, Dubawnt River (A)

Excerpt from Journal, August 19:

Pete found point on raised beach east of camp about a mile.

August 20 (near same camp):

. . . saw stone men lining river every 30 yards. . . . [Moffatt refers here to stone constructions which are found widely on the Barren Grounds. Their builders, the Caribou Eskimos, call them *inukshuit*, meaning "looks like a man," as indeed they do when viewed in silhouette on a skyline. Placed in alignments at strategic crossings on the caribou migration paths, they serve to divert a moving herd into the hunters' ambush.]

Grinnell indicated to me that the above camp and site were located on the east side of the river approximately at 62°45′50″ N by 102°38′ W (Dubawnt Lake, Sheet 65 NW and 65 NE). The specimen was not in the collection.

Site 8, Dubawnt River (B)

Excerpt from Journal, August 31:

Got past first rapid where river bends east, then had to pull ashore — next rapid had to be run on right but channel narrow and wind would have blown us on rocks. Made camp on N bank, on site used by Eskimos — 3 tent rings, rock as lichen covered as those in place — 1 kayak stand, several stone men, and a couple of depressions among boulders with built up walls — stone houses?

September 3 (in the same camp after several days of storm):

Morning cold and no good for travel, so while men went to tents, I searched ground for artifacts, found one point and piece of worked wood.

Approximate location of Site 8: 63°37′50″ N by 100°38′50″ W (Dubawnt Lake, Sheet 65 NW and 65 NE). Presumably the artifacts were found in the Eskimo camp noted above, but they were not included in the collection that I received.

Site 9, Grant Lake

Excerpt from the Journal, September 7:

. . . got to top of Grant Lake, saw red gas cans, and white thing (tent?) on east shore. Paddled over to lee of sand point. . . . went into little gap in esker, found good lee and camped in lovely valley—caribou ground. . . . George discovered many sites on beach west side of esker. . . .

September 8 (in the same camp):

I examined sites, collected many specimens and walked along esker north. Pete found good points on top of esker.

Approximate location of site: 63°43′20″ N by 100°26′10″ W (Dubawnt Lake, Sheet 65 NW and 65 NE). In Tyrrell's (1898: 64 F) report there is further descriptive information which probably applies to this same locale:

Just north of Grant Lake, in north latitude 63°44′30″, is a hill or esker, 270 feet high, composed of sand and rounded pebbles and cobbles. Around its base are deep kettle-holes, many of them containing ponds of water. The western side, facing the river, is moderately steep, and on it are three fairly distinct terraces or old beaches, the highest one being 120 feet above the lake, probably marking the highest ancient marine shore line.

Despite the difference of a minute in latitude between these two descriptions, it seems evident from the map that they both refer to the same distinctive topographic feature at, or near, the northeast end of Grant Lake. (During the summer of 1958, while making a survey of the Thelon River country, I flew back in to the Grant Lake site and spent an afternoon on further investigations there. My observations essentially corroborate the facts noted here, but additional data and interpretations may be expected in my forthcoming report on the regional archaeology.)

I have a total of 52 specimens from several sites located on the esker: 32 of these are positively associated, according to Grinnell's additional testimony, with the lowermost of the three terraces mentioned by Tyrrell. The other 20 are known only to have been collected on top of the esker, as noted in Moffatt's Journal. Apparently none of these artifacts relates to Tyrrell's intermediate or highest terraces. Inasmuch as there is insufficient information to make further distinctions among these sites, I shall henceforth refer to groupings in terms of their association with either the lowest terrace or the esker top. The 32 artifacts (Fig. 3 *a-x*) from the lowest terrace, including both fragments and whole specimens, consist of 15 projectile points, six blades or knives, three scrapers, two burins, two unmodified prismatic blades, three unutilized and unmodified chips, and one rubbing stone, or hone. All of these specimens except the hone are made of a fine-grained quartzite; the most significant of them are illustrated (Fig. 3 *a-x*).

There appear to be at least two distinct types of projectile points, of which the predominant form is lanceolate (Fig. 3 *a-l*). The latter are all characterized by extremely fine workmanship, expertly controlled, shallow pressure flaking on both surfaces, and in some instances occasional delicate retouching of the edges. There is a tendency on some specimens (notably Fig. 3 *b*) for the flaking to angle upward or downward from the edges toward the median line of the blade, thus creating a chevron effect. Most of the specimens exhibit bilateral symmetry, and the cross sections are smoothly rounded and biconvex. One point (Fig. 2 *l*) departs from this norm in having more distinct longitudinal ridges and a diamond-shaped cross section. The maximum thickness of these points, which generally occurs near the middle of the blade, ranges from 7.9 mm. to 9.9 mm.; Figure 3 *d* differs in that it is thickest near the tip. The bases of all points have been thinned by careful longitudinal flaking; typically they are square, but two (Fig. 3 *d, i*) are excurvate. The lateral edges of all basal portions are ground smooth, and on several whole specimens this grinding extends consistently close to one-third of the over-all length of the point. If this is dependable as an index, the lanceolate type, as represented in the Moffatt Collection, varies in length from approximately 5.1 cm. (Fig. 3 *i*) to about 10.5 cm. (Fig. 3 *f*). In general, the basal grinding causes some of these specimens to have a slightly pentagonoid outline, although Figure 3 *k* is aberrant with its suggestion of a shoulder on one edge. Other curious departures from this symmetry are to be noted in several of the points. Two specimens (Fig. 3 *a, b*) are purposefully offset at the tip and possibly were hafted as knives. The constricted tip of one point (Fig. 3 *c*) is probably explainable as a fault in

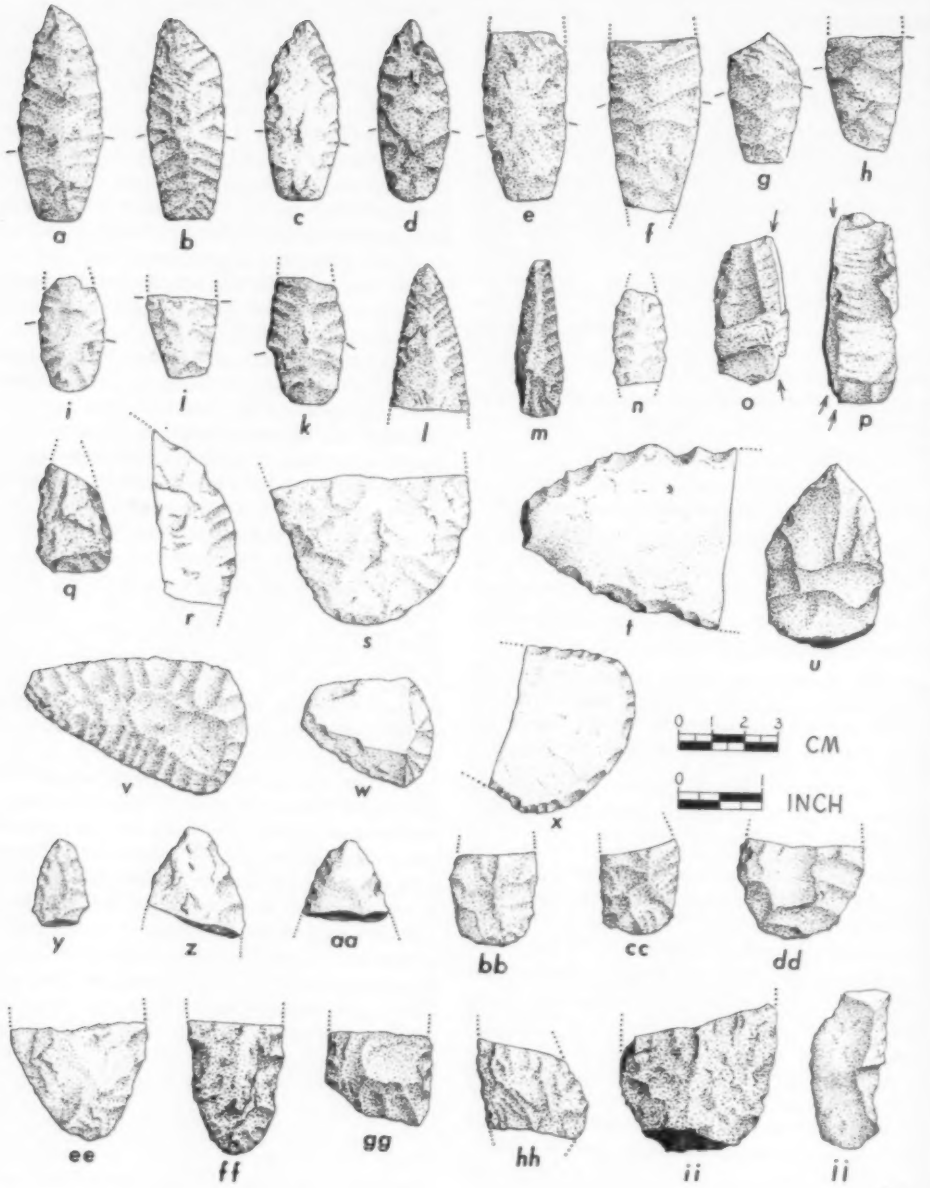

FIG. 3. Artifacts from the Grant Lake site. *a-x*, Site 9, Grant Lake, lowest terrace; *y-jj*, Site 9, Grant Lake, esker top. Short lines at sides of points indicate extent of basal grinding.

chipping, but Figure 3 *d* can be identified as a crude angle burin. In this coarse quartzite material it is not easy to discern the characteristic details of the burin technique, but there is sufficient evidence here of transverse chipping downward from the tip and resultant hinge fractures. One other point specimen (Fig. 3 *g*) also may be classed as a crude angle burin. It appears to have been broken about midway across the blade, but was subsequently modified to a point by means of semitransverse chipping. The altered tip was evidently used as a burin or graver.

The second type of point which can be distinguished in the collection is represented by one specimen only (Fig. 3 *m*). A narrow form, it is made on a prismatic blade and shows careful pressure flaking over most of both surfaces. The cross section is plano-convex, and the maximum thickness 5.8 mm. One fragment (Fig. 3 *n*) appears to be similar, although it lacks a pronounced dorsal ridge. In addition to the crude burins described above, there are two others of more positive character (Fig. 3 *o*, *p*). These seem originally to have been blades or points comparable to the lanceolate type mentioned above. One face of each bears the same smoothly executed flaking, but the opposite surface is scarred by longitudinal flaking or fluting. One, pictured with the fluted surface up (Fig. 3 *o*), is a double angle burin; along the right edge a single burin spall has been struck off from both the top and bottom corners. The other, also shown with the fluted surface up (Fig. 3 *p*), is a single angle burin. Its left-hand edge consists of a full-length longitudinal facet at a right angle to the blade face. This facet may be a remnant of a fluted core surface, but at the lower left corner at least two short burin spalls have been removed.

Of the various types of knives or blades in the collection, three have been purposefully shaped: a somewhat roughly flaked blade, biconvex in section, and 7.8 mm. thick (Fig. 3 *q*); a fragment of an indeterminate form, also a biface, with a fine pressure retouch along the working edge, and a maximum thickness of 7.8 mm. (Fig. 3 *r*); one very like the lanceolate points in the smooth perfection of its finish (Fig. 3 *s*). Both surfaces of this third specimen are entirely worked, and the edges are also bifacially retouched. Although the original shape of the blade can only be guessed, the slight suggestion of a broad stem and narrow shoulders should be noted. The maximum thickness of this fragment is 7.5 mm. Part of a large blade (Fig. 3 *t*) that was struck from a core with a prepared striking platform has roughly percussion-chipped lateral edges on one face only; a random flake or core fragment (Fig. 3 *u*) which has portions of its edges retouched by pressure flaking. The three end scrapers are all thin blades that have been unifacially flaked and retouched. One (Fig. 3 *v*) has the same skilled finish as the lanceolate points. Its upper surface is smoothly rounded and entirely flaked, the forward nose is steeply retouched, and both lateral edges appear serviceable for cutting. The second (Fig. 3 *w*) has a ridged back with two facets; in addition to the steep end-retouch, the right side has also been worked to a cutting edge. The third (Fig. 3 *x*) is steeply retouched across the nose and on both sides.

The small collection made on the esker top consists entirely of fragmentary specimens, including five points, six blades, three modified or utilized chips, four unmodified chips, and a crude prismatic blade. All of these are made of a rough, grainy quartzite. A badly weathered bone knife haft containing copper rivets also came from the esker top and no doubt stems from some relatively recent Eskimo occupation of the area. The only specimen which is sufficiently whole for an estimate of its original form is a small corner-notched point (Fig. 3 *y*). The others (Fig. 3 *z-jj*) are fragments of larger points or blades. These are uniformly biconvex in section and all are bifacially worked by means of rough percussion flaking. There is a finer retouching of the edges in two (Fig. 3 *aa*, *ee*), but none of these artifacts exhibits the highly skilled workmanship which characterizes those from the lowest terrace. Nor is there any important duplication of specific types between these levels, beyond the broad generalization of lanceolate or leaf-shaped forms.

CORRELATIONS

Of the nine sites there are four which merit further brief discussion: Site 3, Boyd Lake; Site 4, Barlow Lake (A); Site 5, Barlow Lake (B); and Site 9, Grant Lake. These are divisible into two main groupings which include, on one hand, the material from the lowest terrace at Grant Lake, and, on the other, Sites 3, 4, and 5, together with the esker top of Site 9. The only basis for this distinction lies in the uniqueness of the artifact types and the delicate techniques of workmanship which characterize the lowest terrace culture at Grant Lake. Inasmuch as other data are

lacking, such a classification can be reliable only for preliminary descriptive purposes. If we consider first the larger grouping, there is less certainty that it constitutes a real cultural unit, for the inventories are small and few strong diagnostic traits cross-cut through all four sites. Primarily, the industry is founded on blade tools which show considerable use of coarse, bifacial percussion flaking. The sites also seem to be linked by side-notched and corner-notched, or contracting-stemmed, projectile points, and one sees some duplication of ovate knives and leaf-shaped blades. These similarities, however, apply most of all to the Boyd and Barlow lake sites, and thus it might be suggested that Sites 3, 4, and 5 are manifestations of a single cultural complex. The relationship between the fragmentary artifacts from the esker top at Site 9 and this Boyd-Barlow complex is impossible to define exactly.

The original ecological setting of this group of sites is not perfectly clear either, yet undoubtedly Site 9 marks an adaptation to the tundra and probably to caribou-hunting. It may be surmised that the Boyd-Barlow complex had a similar orientation, although the traces of it that we have are scattered in the present-day transitional forest zone. All of the sites were apparently hunting encampments located on hilltops or other high vantage points, but the presence of quantities of chips at Site 4 suggests that here was a longer occupation, or perhaps a workshop area. As for possible cultural linkages between this group and peripheral areas, the slightness of the evidence makes comparison difficult. We do not know the complete, true character of the culture deposited in these sites, and hence cannot determine any of its peculiar technological emphases on specific implement types. It is noteworthy, however, that most of the types represented here are matched in the Lockhart River complex which lies some 200 miles northwest, near the eastern end of Great Slave Lake (MacNeish 1951). Lockhart River, in its turn, shares the same traits, as well as others which are not represented in this small collection, with the Dismal 1 and Kamut Lake complexes of the northern Coppermine River country (Harp 1958). Therefore, pending further archaeological research in the Dubawnt watershed, it may be postulated that the Boyd-Barlow complex, and possibly the material from the esker top at Grant Lake, partake of an early cultural diffusion which spread from the western Arctic through the Barren Grounds.

The collection made on the lowest level of Site 9 at Grant Lake is much more promising in that it consists of 32 artifacts and four functional types, one of which comprises 44% of the total inventory. Two of these types, the knives and end scrapers, may for now be ruled out of consideration because they lack positive diagnostic value, but the projectile points and burins have most interesting affinities which, in my opinion, link this site with certain paleo-cultural traditions of both the Plains and the Arctic. The Grant Lake lanceolate points have two possible sets of counterparts in the adjacent Arctic. One of these is the Artillery Lake complex at the northeast end of Great Slave Lake (MacNeish 1951). Here the similarity seems quite obvious, although basal grinding, which is a constant at Grant Lake, is not mentioned as an attribute of the Artillery Lake specimens. Giddings (1956, Fig. 75) illustrates two basally ground, bifacial blades which are vaguely similar, from his Site 4 on the Maguse River, N.W.T., yet the chain of relationships which he sketches with the western Arctic clearly trends toward an Angostura type of point (Wormington 1957: 138-41). This cannot definitely be said of the Grant Lake points.

As a possible supplement to these immediately peripheral affinities, there seems to be a farther-flung alternative. The Grant Lake points appear to have close parallels in the Agate Basin collection first reported by Roberts (1943) from eastern Wyoming and later illustrated by Wormington (1957, Fig. 46). I have not seen the Agate Basin material, but the photographic likeness of some of its specimens to the Grant Lake points, supported by textual description, seems unmistakable. In certain instances they are almost exactly alike, even to the occasional reworked, offset blade tip. There are differences too, of course, but they seem irregular rather than standardized, as, for example, the chevron-like flaking on several Grant Lake points, and the single shouldered specimen (Fig. 3 *k*). These are not attributes of the Agate Basin series. Apparently, too, the Grant Lake points differ in that their bases are always ground in addition to the basal lateral edges, whereas this feature is sporadic in Agate Basin. It is unfortunate that further comparison of the Agate Basin and Grant Lake sites is not possible at this time, for neither has been thoroughly investigated. The other major diagnostic in the lowest terrace cul-

ture at Grant Lake is the burin, a tool that is associated with essentially Arctic cultures in the New World. It is characteristic of the Cape Denbigh Flint complex in Alaska (Giddings 1951) and of those microlithic cultures in the central and eastern Arctic which are believed to have descended in large measure from Denbigh. It is also known in nonmicrolithic contexts which antedate the Denbigh tradition in given localities, such as the lowest horizons at Firth River (MacNeish 1956). Thus, in terms of this particular trait, the Grant Lake lowest terrace culture must be derived from the prehistoric spread of culture across the Arctic zone. More specifically, the Grant Lake angle burins have their closest parallels with types found in the New Mountain and later levels at Firth River and also in the Independence I culture of northeastern Greenland (Knuth 1956).

Hence, in this small collection from Grant Lake there is probable evidence of a fusion of Arctic and Plains traits, although nothing to suggest that the compounding action itself occurred there. This highlights once more the developing problem of how such Plains traits came to appear in the far north where, in recent years, perfectly good points of Folsom, Eden, Plainview, Angostura, and Scottsbluff type have been found in a number of widely dispersed sites (Hibben 1943; Thompson 1948; Skarland and Giddings 1948; Collins 1951; Giddings 1951; Larsen 1951; MacNeish 1951, 1953; Harp 1958). As for the Grant Lake site, this much can be said: its situation in the far Keewatin District shows that it would have been subject to obliteration by all but the final, localized advance of the ice which came approximately 4000 years B.P. (Flint 1956: 280-1). We might presume, then, that the lowest terrace was occupied sometime during the Thermal maximum, or Altithermal period, of the preceding millenium. (In passing, it might further be conjectured that the cultural remains on the esker top at Grant Lake stem from some theoretically older occupation of this same locale, but the present facts are too few to confirm or negate such a proposition.) The Agate Basin site, in turn, offers little clarification of this dating problem (Roberts 1943). The point types found there clearly belong to the collateral variety of parallel flaked points which are so distinctive in many ancient cultures of the Plains. This relationship is confirmed by indications of antiquity in the geological context. However, the bones of modern *Bison bison* associated with the Agate Basin points give an opposite impression of less antiquity. Therefore, this occupation may have been a borderline case that came toward the end of the Anathermal period, or in the early stages of the Altithermal when the paleo-hunters were spreading farther afield in the drying grasslands (Quimby 1954).

In the final balance, as viewed from the Grant Lake area in the Northwest Territories, I think the evidence, although slight, weighs in favor of a northward diffusion of Plains culture. It may be suspected that such a movement was stimulated by the desiccation of the Plains and the shifting ecological patterns that coincided with the latter stages of glacial retreat. While the Moffatt Collection may not have furnished us with final answers to these complex problems, it has surely broadened our perspective of them. Moreover, it may well be an important instrument in their ultimate solution, in that it will have directed our attention to the marginal country of the Barren Grounds where decisive clues may yet be found.

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FACTS AND COMMENTS

LANCEOLATE POINTS AND FOSSIL BEACHES IN THE UPPER GREAT LAKES REGION

Lanceolate points, formerly called "Yuma," but now designated by specific type names such as Plainview, Milnesand, Eden, Browns Valley, and others, seem to have been various expressions of a common pattern or tradition that has been called "Plano" by Jennings (Griffin 1957: 23). The Plano tradition in the West represents an ancient hunting stage of culture that followed an earlier stage manifested by the paleo-Indians who used fluted points and hunted elephants of types now extinct.

A similar situation exists in the upper Great Lakes region. The Plano tradition is more recent than the fluted point tradition. But since the lake region sites and Plano points are usually found in association with fossil beaches and other expressions of former water planes, it seems appropriate to use the term "Aqua-Plano" to designate the Plano tradition in the upper Great Lakes region. Most of the Aqua-Plano points found in the upper Great Lakes region have been surface finds. There are, however, some excavated sites in the northern parts of the area.

Westernmost is the Browns Valley site (Jenks 1937) in the basin of glacial Lake Agassiz, one of the upper Great Lakes during its existence. This site, in Traverse County, Minnesota, consisted of a burial and artifacts in a grave pit dug into a gravel ridge before the development of humus on the ridge. The ridge was formed as a gravel bar in the southern outlet of glacial Lake Agassiz and any burial in this ridge should be later than any stage of glacial Lake Agassiz that drained southward. Glacial Lake Agassiz last drained southward during the Valders advance (Elson 1957) about 9000 B.C. and continued to do so until the retreating Valders ice opened lower eastern outlets about 8000 B.C. permitting Lake Agassiz to drain into the Lake Superior basin. Consequently the Browns Valley site must date from a period later than about 8000 B.C.

Elson (1957) stated that lanceolate points of Plainview and Agate Basin types were distributed around the periphery of Lake Agassiz II. This distribution, which is indicative of lake shore habitat, shows a correlation between Lake Agassiz II and lanceolate points. Lake Agassiz II lasted from around 9000 B.C. to about 3000 B.C. or slightly later and the occupancy of the Agassiz district by Indians using lanceolate points would be in some period between 9000 B.C. and 3000 B.C.

Lanceolate points also have been found around the periphery of an old lake bed in the vicinity of Fort William, Ontario, in the western end of the Superior basin. Some of these points are made of taconite and show oblique, parallel flaking.

About 25 miles northeast of Fort William near Pass Lake, Ontario, in the Thunder Cape district is the Brohm site (MacNeish 1952) where Plainview and other Aqua-Plano points of chipped taconite were found in association with fossil beaches. The taconite points and other artifacts were found in the upper 9 inches of pebble and clay beach deposits that were overlain by deposits of humus. The artifacts were in the beach deposits before the humus zone developed on top of the gravels, suggesting that Indians lived near the water's edge on top of the gravels shortly after the deposition of the beach. Thus a determination of the age of the beach provides an approximate date of the occupancy of the site.

Because of postglacial upwarping of northern lands the Brohm site beaches are now 224 to 230 feet above the present level of Lake Superior. At this elevation the beaches must represent the Minong stage, a period of low water levels in the Superior basin. The reasons are as follows.

According to George M. Stanley (in Sharp 1953: 128), the elevation of the highest of a continuous series of Minong stage beaches at the southwest end of Isle Royale is 83 feet above Lake Superior and their angle of tilt, as measured on Isle Royale, is 2.6 feet per mile along a line bearing N 22° E. Projecting this water plane from southwestern Isle Royale 55 miles along a line bearing about N 22° E to the Brohm site, the anticipated elevation of the Minong strand would be 226 feet above Lake Superior, a good correlation between the upper part of the Minong series on Isle Royale and what must be the upper part of the Minong series at the Brohm site where the actual beach elevations range from 224 to 230 feet.

What is the age of the Minong beach? On the east shore of Lake Superior in the vicinity of Montreal River the Minong beach is the highest and first postglacial beach to be registered but farther south on the east coast at Goulais it is the fifth beach stage in the Post Algonquin series (Stanley 1941; Greenman and Stanley 1943: 521-8). This position places the time of the Minong beach either early in the Chippewa-Stanley stage of the upper Great Lakes region or late in the preceding stage and suggests a date on the order of 7000 B.C. to 5000 B.C. for the occupancy of the Brohm site.

In the northern part of the Lake Huron basin there are two important sites that have produced some lanceolate points. One of these, a quarry and workshop site, is at Sheguiandah, Ontario, on the eastern end of Manitoulin Island (Lee 1953, 1954, 1955, 1956, 1957). The geological details are complicated and subject to some disagreement. However, it seems obvious that the Sheguiandah site was under ice during the Valders glacial advance about 9000 B.C., and that as the Valders ice retreated the site was beneath the waters of glacial Lake Algonquin.

If the Sheguiandah site were occupied only in some period after the Lake Algonquin stage, the hypothesis suggested here, then the earliest possible occupancy would have been at a time when the surface water in the Huron basin had been lowered 300 to 350 feet from the level of glacial Lake Algonquin, a proposition necessitated by the position and present elevation of the site. Upon this basis the earliest possible occupancy of the Sheguiandah site would have been in the falling water stages following glacial Lake Algonquin and Lake Payette

(Greenman and Stanley 1943) but before the Lake Stanley stage which began about 6000 B.C.

One radiocarbon date (W-345) from the site, 7175 B.C. ±250 years (Lee 1956; Rubin and Alexander 1958: 1483), seems a bit early, but could be as late as 6425 B.C. if no error other than statistical error due to radioactive process were involved (Broecker and Kulp 1956: 5). Sometime between 7000 B.C. and 6000 B.C. seems to me to be a proper estimate for the earliest occupancy of the Sheguiandah site.

The use of the Sheguiandah site may have continued into the Nipissing stage of the upper Great Lakes, about 3000 B.C. to perhaps 1000 B.C., because the area of site occupancy rather abruptly terminates at the Nipissing water plane which at this place is about 70 feet above the present level of Lake Huron. The points associated with the site are usually of chipped quartzite. Some of these points are of Aqua-Plano types whereas others resemble the notched and stemmed forms of the Old Copper and other Archaic cultures. Such a range of point types seems in keeping with a period of occupancy some time between about 7000 B.C. and 1000 B.C.

On the Ontario mainland about 20 miles east of Sheguiandah near the village of Killarney is the George Lake site (Greenman and Stanley 1943). This, too, is a quarry and workshop site where the Indians utilized the abundant white quartzite. Among a multitude of flakes, cores, and heavy quartzite forms, possibly quarry blanks, there have been found two Aqua-Plano points. The cultural materials at the George Lake site were associated with a fossil beach 297 feet above the present level of Lake Huron. Some of these materials were on and in the upper parts of the beach. Some of the artifacts were waterworn as if subjected to wave action (Greenman and Stanley 1943).

The fossil beach associated with the George Lake site is about 180 feet beneath the anticipated water plane of glacial Lake Algonquin as projected from eastern Manitoulin Island and correlates with the beach series of the Cedar Point stage (Greenman and Stanley 1943). The George Lake site would have been underneath glacial ice prior to and during the Lake Algonquin stage of the upper Great Lakes and would have been under water during the Wyebridge and Penetang stages. Thus the earliest possible occupancy of the George Lake site would have been in a period later than glacial Lake Algonquin, but earlier than Lake Stanley or some time between about 7000 B.C. and 6000 B.C.

The Aqua-Plano tradition seems to have been dominant in the upper Great Lakes region between about 7000 B.C. and 4500 B.C. This time span embraces the Post-Algonquin lake stages: Wyebridge, Penetang, Cedar Point, Payette, and Minong as well as the first half of the Chippewa-Stanley stage. It was a period of general glacial retreat, falling water levels, and increasing warmth of climate. The Valders ice, still in the eastern Lake Superior basin and parts of the northern Lake Huron basin at the beginning of the period had retreated to northernmost Ontario by the end of the period.

The lakes in the Huron, Michigan, and Superior basins became considerably reduced in area because of falling water levels caused by drainage through low eastern outlets uncovered by retreating ice. There were two additional lakes of great size in the region. On the northwest lay glacial Agassiz whose waters drained to the Superior basin and to the north lay glacial Lake Ojibwa-Barlow.

In the beginning of this period spruce and pine trees dominated the forests, but by the end of the period pine had won over spruce in the southern parts of the region. In the north there was a brief increase of spruce toward the end of the period and following a minor glacial advance, the Cochran, in northern Ontario. The fact that Aqua-Plano cultural remains have been found much farther north in the upper Great Lakes region than have been fluted points suggests not only that the Aqua-Plano people were later occupants of the region but also that there was a northward movement of people following the retreating glacier and northward moving zones of vegetation and animals.

Also, the attempts of Aqua-Plano Indians to produce blades with parallel flaking from such ill-suited stone materials as quartzite and taconite suggests that these Indians had come from or were influenced from areas in which there were types of stone more suitable for a parallel flaking technique.

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Chicago Natural History Museum
Chicago, Ill.
February, 1958

ARCHAEOLOGY AND THE AINU

At the present time little is known in the Western world about the archaeology of Hokkaido, Japan. Groot (1951) is of limited value for most of his explorations were in the Tokyo area. This dearth of evidence is extremely regrettable in view of the so-called "Ainu problem" about which so many speculations have been published during the past century. During 1953-54 while stationed in Hokkaido with the United States Army, I explored and visited a number of prehistoric sites and made several collections which are now in the U. S. National Museum. Of the many sites visited, three in the southwestern part of Hokkaido in the Sapporo area were chosen for partial excavation. Radiocarbon dates for these sites were determined by the U. S. Geological Survey Radiocarbon Laboratory through the courtesy of Meyer Rubin.

The Taniguchi site is a Middle Jomon occupation on an old sand dune at Barato on the Ishikari River north of Sapporo. The village refuse is about 2½ feet deep, but shows no cultural change from bottom to top. Sherds are plentiful, and all are of the Yoichi type, equated by Groot with the Middle Jomon of Honshu. In addition to the pottery, there are many stemmed projectile points of obsidian. Charcoal was the only organic material found in the approximately 26 square yards excavated. This charcoal (Sample W-372, run late in 1955) yields an age of 3950±200 years (Rubin and Alexander 1958: 1486).

Uenae is just north of Tomakomai on the south coast of Hokkaido. The most important part of this site is a stratum of black soil buried under about 5 feet of overburden which consists of two volcanic ash deposits separated by a second stratum of black soil. The profile was exposed in a roadcut, and excavations were limited to a test strip 5 by 15 feet parallel to the road. Four components are found: Middle Jomon (Yoichi type pottery) and Later Jomon (Nopporo pottery) in the lower black layer, Final Jomon (Ebetsu pottery) and Epi-Jomon (Haji pottery) in the upper black zone. Stone implements include flint and obsidian stemmed and triangular projectile points, celts, and numerous flake scrapers. Charcoal from a pit containing Nopporo pottery which was under the deeper layer (Sample W-322, run late in 1955) is assigned an age of 3230±160 years (Rubin and Alexander 1958: 1486).

Osatsu, just north of Chitose, consists of numerous rectangular pit-dwellings similar in many respects to those in Aomori Prefecture in northern Honshu (MacCord 1955). Two of these housepits were completely cleared; pottery and stone implements were found in each. The pottery of the pit-dwellers is of the Haji type, though one bowl was made on a potter's wheel. Charcoal from remains of roof timbers from House 1 (Sample W-419, run late in 1955) was given an age of 1100±150 years (Rubin and Alexander 1958: 1486).

The evidence obtained from these excavations and the radiocarbon dates permit the conclusions that cultural sequences on Hokkaido parallel closely those on Honshu and that they share the same antiquity. The Neolithic way of life persisted in Hokkaido until about A.D. 800, when numerous historical references to coastal outposts of the expanding Yamato Empire of southern Honshu are available. These facts tend to discredit the hypothesis that Hokkaido was a refuge area for peoples driven north from Honshu. On the contrary, they indicate that the aboriginal inhabitants of Hokkaido were identical culturally to those of Honshu. Perhaps they may also be identical racially.

The commonly accepted reconstruction holds that the Ainu were the prehistoric inhabitants of all Japan as far south as Tokyo, and that the Ainu were driven north to Hokkaido as recently as A.D. 800. This interpretation also holds that the Japanese who migrated from Honshu to Hokkaido had to fight long, devastating wars with the Ainu before subduing them and forcing them to live in remote parts of Hokkaido. Moreover, it is held that the Ainu then abandoned the art of pottery making, changed their house style, and became dependent on the Japanese for almost all manufactured articles.

Such a radical change in Ainu culture is extremely doubtful in view of the conservatism of the Ainu as demonstrated by their retention, until as recently as the turn of the century, of so many of their customs, such as mouth-tattooing of women, pole-and-thatch houses, the bear cult, and the highly developed hunting and fishing techniques. I find it more credible to postulate that the Ainu have always lived as hunters without pottery in villages of pole-and-thatch houses. I suggest, therefore, the hypothesis that the aboriginal inhabitants of Hokkaido were Mongoloid proto-Japanese of the same stock as those of Honshu, and that they merely adopted the

Japanese way of life when it was brought to Hokkaido by traders and colonists in historic times. There is no evidence for a break in the development of the cultures of Hokkaido. In fact, the evidence points to a continuum from Early Jomon to historic times.

Moreover, I strongly recommend that a qualified physical anthropologist visit Hokkaido and examine closely the skeletal remains found in the shellheaps and in such caves as that at Fugoppe, near Otaru, where Middle and Final Jomon pottery is found. I am reasonably sure that he will find the human types to be very similar to contemporary Japanese and quite unlike the historic Ainu. The Hokkaido University in Sapporo has hundreds of well-documented Ainu skeletons, so that comparative material is not lacking. When such a study is made, I feel sure that the many myths which have surrounded the Ainu will largely be dispelled, and that the prehistory of Japan will be seen in clearer perspective.

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HOWARD A. MACCORD
Laurel, Md.
July, 1957

CURVILINEAR MOTIFS ON NEW YORK COASTAL POTTERY: A REPLY

Robert C. Suggs (1958: 432-3) mentions having found at the Manakaway site in Greenwich, Connecticut, sherds from a vessel decorated with curvilinear motifs in dentate stamping. At the Pelham Boulder site, Bronx County, New York, similar pottery has been found by the writer in the subsoil, and within the lowest third of the midden, never higher. Suggs implies that I attributed the sherds to "Hopewellian contact" in a short preliminary paper I wrote (1956). Nowhere in my paper have I mentioned a Hopewellian contact. I did say, however, that "such motifs are *reminiscent* of some Hopewellian patterns." There is quite a difference in meaning and implication.

I might add that further research on my part (Lopez 1958) discloses that the Pelham pottery is related to the Abbott Zoned Dentate stamped ceramics defined by Cross (1956: 147, 179), who also sees a possible connection with, or a remote inspiration from, the Hopewell culture during Middle Woodland times. Abbott Zoned Dentate has also been found at Pelham together with other pottery members of the Abbott complex.

The statement was made by Suggs that curvilinear elements are both early and late. As early examples he cites Matinecock Point Stamped (Smith 1950: 196). In this respect he is right. However, for late examples he only refers to one collared-rim sherd of Van Cortlandt Stamped which was illustrated by Skinner (1909: 118). The specimen is unquestionably late but the design in this case is the only one known from coastal New York even though Van Cortlandt Stamped is common on many sites. The "curved lines," actually consist of a series of short, straight lines which are connected in such a way as to suggest crescentic elements. The effect is clever but not truly curvilinear. Significantly, Skinner, who commented about curvilinears in the very same paper (1909: 120), did not refer to the Van Cortlandt specimen as an example; instead he had to refer the reader to a sketch by Bolton (1909, Fig. 9 *b*) for a true instance of a curvilinear decoration on a local sherd. This particular specimen is Matinecock Point Stamped.

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JULIUS LOPEZ
New York City Archeological Group
New York, N.Y.
May, 1958

RADIOCARBON DATES FOR THE BULL BROOK SITE, MASSACHUSETTS

Descriptive articles (Eldridge and Vaccaro 1952; Byers 1954, 1955, 1956) have discussed various aspects of the Bull Brook site. Byers (1955) describes in considerable detail the conditions under which certain artifacts were

recovered. In August and September, 1957, crumbs of charcoal were found in another part of the site by W. A. Eldridge and the Vaccaros; Byers was notified and in September he personally recovered charcoal under conditions which confirmed previous reports about its occurrence. This charcoal differed in character and in distribution from that mentioned by Byers (1955: 274). Charcoal collected by Eldridge in 1955 had been set aside until an opportunity came to observe charcoal in situ. The charcoal recovered by Byers was found under conditions similar to those under which fragments of bone were found in 1954 (Byers 1955: 275, Fig. 80). In yellow-brown sand (B horizon) there appeared a diffuse reddening of the soil over an area of no more than 10 feet in diameter and approximately 0.8 foot in depth. At the limits of the zone, the reddening faded gradually so that it was impossible to draw a sharp boundary. Within the reddened zone there occurred artifacts of characteristic Bull Brook forms, chips of the stone from which they were made, and crumbs of charcoal. No charcoal, artifacts, or chips were found outside the reddened zone. Charcoal occurred at random throughout the reddened zone, above, below, and on a level with artifacts. The charcoal *does not* represent a hearth; it comprises bits and fragments which have been blown away from sites of fires to settle in sheltered spots. It may, therefore, represent a considerable span of time during which the site was occupied, and may be considered as sampling many fires built during this time. Some crumbs have the appearance of having been rolled, while others seem to have been etched by wind-driven sand.

Four samples of charcoal were sent to James B. Griffin for analysis at the University of Michigan Radiocarbon Laboratory. Thanks are due to Griffin, H. R. Crane, and the Michigan Memorial–Phoenix Project for the processing of these samples. They are listed below with descriptive paragraphs and in years B.P., which are stated in terms of the Christian era by subtracting 1950 years.

M-807 Charcoal collected by W. A. Eldridge in August and September, 1957. Sample was sealed in a sterilized jar and baked in order to kill microorganisms; sent to Ann Arbor in original sealed jar. 9300±400 (7350 B.C.)

M-808 Charcoal collected by W. A. Eldridge in 1955. It was brought to the R. S. Peabody Foundation along with chips and a few artifacts that were associated with it, wrapped together in a foil package. The package contained some rootlets, and these were removed from the charcoal in so far as possible before the charcoal was wrapped in foil for storage at the R. S. Peabody Foundation. Some of this charcoal may have been of animal origin. 8720±400 (6770 B.C.)

M-809 Charcoal collected by D. S. Byers, September 21, 1957. Wrapped in foil and kept at the R. S. Peabody Foundation until shipment to Michigan. J. B. Griffin comments that this is "a small sample that is not regarded as being of the same reliability as the other three runs." 6940±800 (4990 B.C.)

M-810 Charcoal collected by D. S. Byers, September 28, 1957, from the same area as M-809, but after the first rain in six weeks. Wrapped in foil and kept at the R. S. Peabody Foundation until shipment to Michigan. 8940±400 (6990 B.C.)

Ages were determined as of August and September 1958, but specific dates for each run are not listed. They indicate that people were living at the Bull Brook site about 7000 B.C.

Continued workings of the gravel company and operations of Eldridge and the Vaccaros have shown that the site extends over at least ten or 15 acres of the terrace. Such an extensive distribution suggests that the site was occupied for a long time. It seems unlikely that the immediate area would support a population of birds and animals sufficiently large to support a human concentration of this size except during the annual migrations of waterfowl, when birds by the thousands congregated in the adjacent marshes. It is possible that the Bull Brook site represents such a seasonal concentration of paleo-Indians, but I incline to the belief that all the bands of paleo-Indians in New England would not account for a number of people large enough to have made and lost so many tools in a few short years. It should be noted that a log from the base of swamp material on top of outwash, from a site not far from Athol, Massachusetts, dated at 10,800±250 B.P., or approximately 8800 B.C., gives a minimum date for the last glacial substage in central Massachusetts (W-361; Rubin and Alexander 1958).

Ages of samples from Bull Brook are less than the maximum permissible by estimates of Quimby (1958) and Mason (1958), but they fall within the lower limits of both estimates, and thus confirm to a certain extent conclusions reached by these scholars. In view of the congruence of these lines, it appears necessary to reexamine the evidence for high-water stages in the Lake Ontario basin. Ritchie's estimated time range of 5000 to 3500 B.C. is based on the assumption that Lake Iroquois and Lake Vermont did not terminate until approximately 7000 years ago (Ritchie 1957: 15). If this estimate is correct, one must conclude that the Lake Ontario basin comprised a sanctuary for paleo-Indians. It seems more likely that Lake Iroquois and Lake Vermont are to be correlated with a glacial substage that is earlier than that indicated by sources upon which Ritchie based his estimate, and that New York State was in step with the upper Great Lakes and New England, from the point of view not only of human culture but also of deglaciation.

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October, 1958

THE AGE OF FEATHER TEMPERING IN ALASKA

J. L. Giddings has been kind enough to call my attention to an oversight in my recent note on the occurrence of organic tempering in northeast Asia and Alaska (Chard 1958), wherein the data adduced indicated a relatively recent date for the use of feather temper on the Alaskan side. Giddings' own excavations in oval house pits on the Choris Peninsula have revealed a thin, well-fired pottery much like that designated as "Norton linear-stamped," but tempered entirely with down feathers (Giddings 1957). Although satisfactory radiocarbon dates have not been secured, Giddings suspects an age of over 3000 years for the site on the basis of crosscultural comparisons, which would make this perhaps the earliest pottery in the area. [See article by Rainey and Ralph, this issue — EDITOR.] Thus feather temper has a far longer history in Alaska, at least comparable to that of grass temper. However, northeast Asia still appears to hold an edge chronologically in the employment of organic materials for this purpose.

CHARD, C. S.

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Madison, Wisc.
December, 1958

ASSOCIATION OF BISON WITH ARTIFACTS IN EASTERN WASHINGTON

In 1954 Warren T. Lee found the horn core of a bison associated with a hearth and four tools on the east bank of the Columbia River, at Quilomene Rapids, in western Grant County, Washington. The site was found when overflow from a reservoir in the Quincy scablands cut a channel through the floodplain terrace. The hearth and associated materials were located in the wall of the channel 4 feet beneath the surface of the terrace. The finds are important because they provide another association of bison with man in the Plateau which is probably equivalent in time to the little-known Cayuse I phase. On the surface of the terrace at this location is a village with pits of at least 100 houses (Lee 1955). Some of the remains from this village can be identified as Cayuse II in age (Swanson 1956). The point associated with bison (Fig. 1 *d*) matches two from a house pit at the Schaake Village near Vantage (Swanson 1958), where this type of point can be established as later than Frenchman Springs III phase. The point of this type associated with bison must be earlier than Cayuse II because it underlies a village of that period. It is probable that these finds are of Cayuse I phase. This would mean an age of about A.D. 1300. This point type may thus have some use as a marker type for the Cayuse I phase in the Central Plateau. Osborne (1953) has discussed questions concerning the presence of bison at a prehistoric time in the Columbia Plateau and has presented archaeological evidence for the presence of bison from late prehistoric time into the historic period. The find reported here provides additional evidence for the distribution of bison in western North America, about A.D. 1300 in terms of the Vantage chronology.

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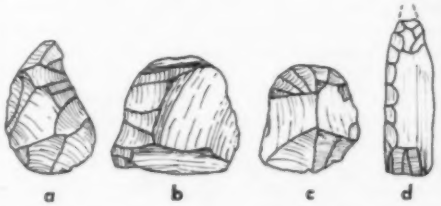

FIG. 1. [Swanson and Lee] Artifacts associated with bison. *a*, pointed jasper implement with bifacial retouch; *b*, large flake scraper of petrified wood with unifacial retouch on one edge; *c*, chert end scraper retouched on one face; *d*, pointed blade of petrified wood with bifacial retouch on one edge and at point. Length of *d*, 1¾ inches.

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1958 The Schaake Village Site in Central Washington. *American Antiquity*, Vol. 24, No. 2, pp. 161-71. Salt Lake City.

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WARREN T. LEE
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June, 1957

A SMALL ROCK SHELTER IN EASTERN WASHINGTON

The artifacts described here were collected by Warren T. Lee in 1953 from a shelter hollowed out of basalt by the action of Crab Creek, the only perennial tributary of the left bank of the Columbia River between the junctions of the Spokane and Snake. The shelter is located in a semi-arid region near the western edge of Adams County where Crab Creek meanders in and out of Grant County on its way to the Columbia River at Beverly, Washington (Fig. 1). Testing revealed two occupation levels and produced a small number of artifacts. The dry deposits, which contain considerable rock fall, are the result of residual decomposition and wind action. Implements from Occupation 1 came from 1.9 feet below the surface; those from Occupation 2 just 6 inches below the surface. The site provides a separation of two common point types in the Central Plateau. The artifacts and associated bones are:

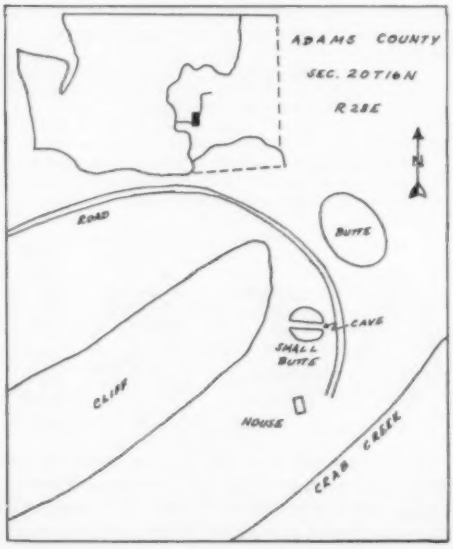

FIG. 1. [Swanson and Lee] Sketch map of the site location.

Occupation 1

1. Bone awl made from deer rib, point ground 1¼ inches up length of rib (Fig. 2 *d*).
2. Triangular, corner-notched point of gray chert with good, flat bifacial retouch, part of both faces remains unretouched (Fig. 2 *b*).
3. Pointed chalcedony flake with unretouched edges, but with diagonal flake removed at tip (Fig. 2 *c*).
4. Tip of chalcedony point.
5. Tip of large chalcedony point.
6. Broken chalcedony core.
7. Chert end scraper on flake with one end and side steeply retouched.
8. Large basalt hammer or pounder, squat, thick river cobble battered on one end by use, otherwise unworked.
9. Small river cobble with shallow, ground, highly polished, dark-stained concavity on one face.
10. Fragment of brown, thick-walled cattail stalk with dark stains on the exterior.
11. A number of bones of an adult deer: three rib fragments; four cut long bones, one charred; right calcaneum; midsection of right cannon bone; distal end of right cannon bone; portion of radius; seven thoracic vertebrae; atlas; six teeth.
12. Three fragments of unidentified rodent long bone.

Occupation 2

1. Bifacially retouched chalcedony point with tip missing, workmanship poor, part of flake faces untouched by trimming (Fig. 2 *a*).
2. Eight pieces of two-ply cordage with following characteristics:

Twist	*Degree*	*Diameter (in inches)*	*Material*
2-S	5	1/32	finely shredded apocynum
2-S	15	1/64	finely shredded apocynum
2-Z	15	3/8	grass
2-S	10	1/8	cedar bark strips
2-S	15	1/16	apocynum
2-Z	5	1/4	cedar bark
2-Z	10	1/4	cattail
2-S	20	1/8	grass

First two specimens are tied together with a granny knot; last specimen has loop at one end made by carrying end around and laying back into twist.

3. Fragments of twined cedar mat with weft pitched up to the left; warp and weft both of cedar bark strips with weft material somewhat better shredded; warp row consists of loosely bunched cedar strips; openwork with four warp rows to the inch; weft diameter varies from ⅛ to ¼ inch with an interval of 1¼ inches; original size unknown because no selvage remains.
4. A right phalange and a thoracic vertebra, possibly of a bison, more likely of a cow.
5. Distal end of cannon bone of unidentified very young mammal, possibly a fawn.

The importance of the site rests on the stratigraphic separation of the two points and associated materials. The point from the lower deposit, Occupation 1, is similar to points from the Upper Coulee rock shelter (Mills and Osborne 1952, Fig. 107), which Swanson (1956) equated with the Cayuse II phase at Vantage. Although

the difference in time between the two occupations at this small rock shelter cannot be calculated, it is likely that the materials of Occupation 2 are of Cayuse III age, thus providing another distinctive implement for that period which probably extends from late prehistoric time into the early historic era. Since little has been done to define the Cayuse III phase, the small point from the second occupation may be of some value in future work.

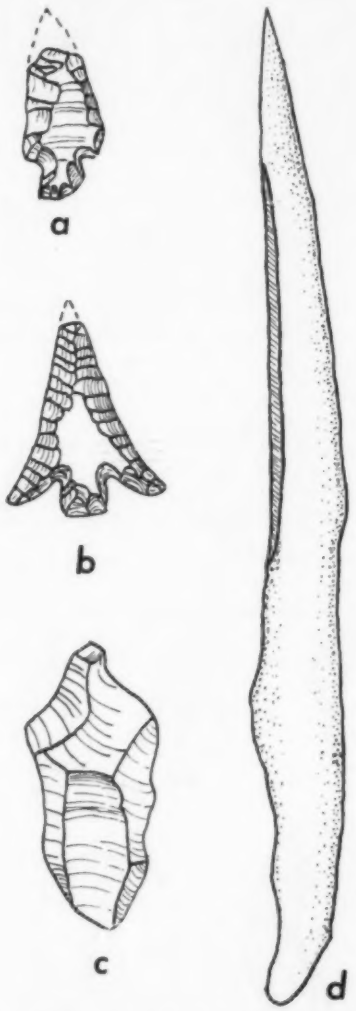

FIG. 2. [Swanson and Lee] Artifacts from the rock shelter. *a*, chalcedony point from Occupation 2; *b*, chert point from (the earlier) Occupation 1; *c*, chalcedony point from Occupation 1; *d*, bone awl from Occupation 1. Length of *d*, 6¼ inches.

MILLS, JOHN AND CAROLYN OSBORNE
1952 Material Culture of an Upper Coulee Rock Shelter. *American Antiquity*, Vol. 17, No. 4, pp. 352-9. Salt Lake City.

SWANSON, E. H.
1956 Archaeological Studies in the Vantage Region of the Columbia Plateau, Northwestern America. MS, doctoral dissertation, University of Washington, Seattle.

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THE EDGAR SITE, NORTHWESTERN WYOMING

The area around Cody in northwestern Wyoming is extremely rich in archaeological sites. One of these, the Horner or Sage Creek site, is now well known as the locus of the Cody complex, a varied group of "Yuma" implements dated about 5000 B.C. (Wormington 1957: 127-8). Extensive tipi-ring sites have been found on the tributaries of the South Fork of the Shoshone River and in other locations near Cody. These so-called tipi rings are perhaps related to those of the Boysen Reservoir in west central Wyoming (Mulloy 1954a). There are also indications of hunting camps of the Crow, Shoshone, and Ogalalla Sioux whose trails met here in protohistoric and early historic times. The Oregon Basin, approximately 7 miles southeast of Cody on the Greybull road, is a large, somewhat circular depression containing a small and shallow lake. While this lake today is not much larger than a waterhole, during the Pleistocene pluvials it could have reached a total extent of about 10 square miles. Pictographs have been discovered both on the sandstone cliffs to the southwest of the basin and directly east of the abandoned Wiley mine located 3 miles southeast of the basin. Two and a half miles to the east at Mud Springs is a group of tipi rings. The entire area today is leased to the Ohio Oil Company and is covered with roads, making access to all parts easy.

Several years ago Robert Edgar of Cody and his father, both active amateur archaeologists, discovered the site which has been named for them. I am grateful to Edgar for taking my wife and me to the site and for loaning me his collection for study. The Edgar site is located just over the south rim of the Oregon Basin, approximately 100 yards east of Sidney No. 4 Well of the Ohio Oil Company, at an altitude of 5290 feet. The site itself is an eroded and windblown surface about 200 yards across, sloping down towards a cattle wallow to the south; the latter may mark a small spring. Surface collections at the site by Robert Edgar, his father, and his brother have produced a large and interesting assemblage of projectile points and other stone artifacts. Further material was collected by my wife and me when we visited the site in July 1957. Altogether there are 75 artifacts from the site

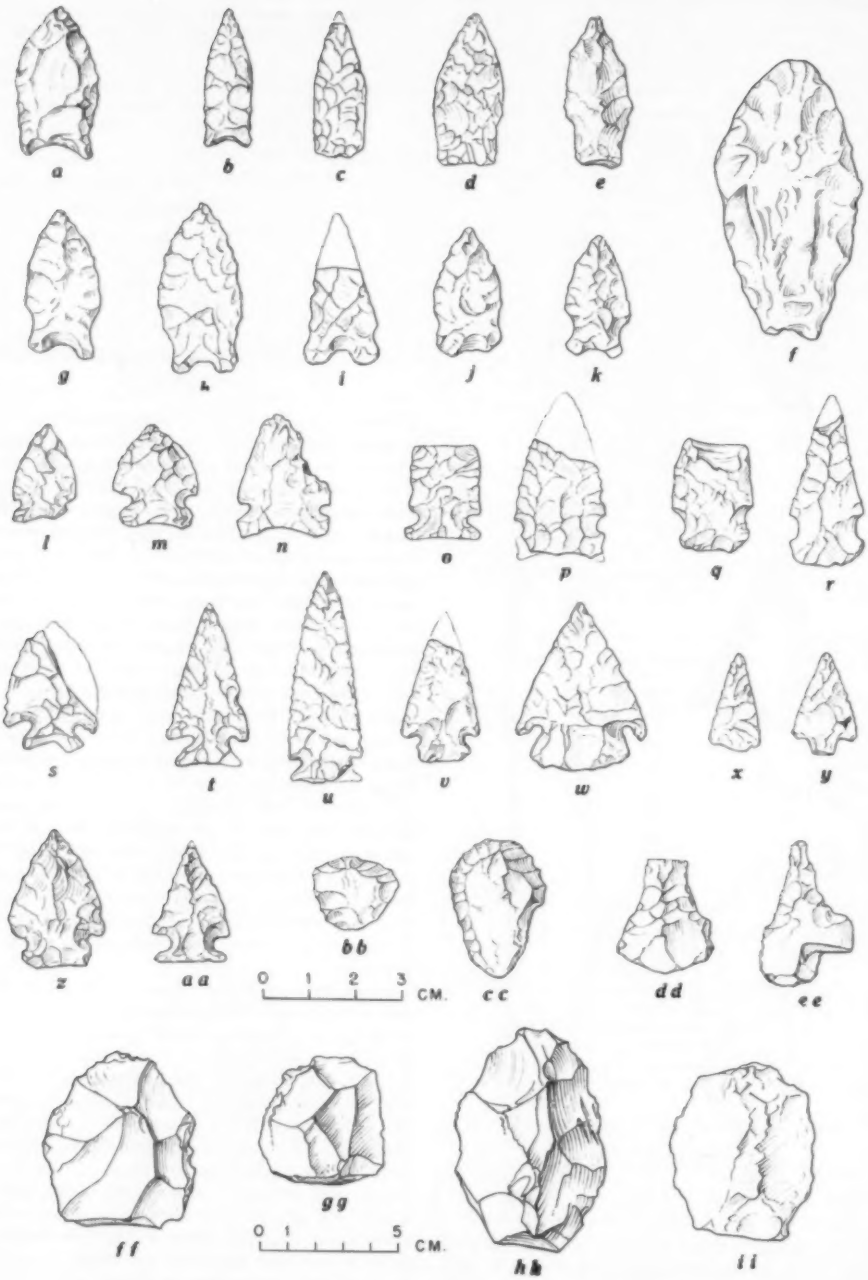

FIG. 1. [Coe] Artifacts from the Edgar site. The drawings were made by Avis Tulloch.

in the Edgar collection; another local amateur is said to have obtained at least this many more from the same site.

Among the 75 artifacts there are 57 projectile points, one knife, four thumb scrapers, two drills, four crude cores, and seven worked flakes. A representative group of these artifacts is shown in Figure 1. Materials used include chert, banded agate, quartzite, fossil wood, obsidian, chalcedony, red jasper, yellow jasper, flint, siltstone, and basalt. One projectile point (Fig. 1 *a*) closely resembles in outline a typical Lindenmeier Folsom; however, on only one side are there any indications of fluting, and even this was not carried out successfully. This specimen was actually obtained by Edgar from another local collector who claims to have found it on the site. The rest of the points can easily be duplicated in the assemblages from the McKean site in northeastern Wyoming (Mulloy 1954b, Figs. 4, 5). The following specimens lie within the range of variation of the Lower Level at the McKean site: small, unstemmed points, often with slightly indented bases (Fig. 1 *b-e*); points with basal notches and indications of stem constriction (Fig. 1 *g-k*); thumb scrapers which are probably of slight importance as diagnostics (Fig. 1 *bb, cc*). The artifacts which resemble items from the Upper Level at McKean include: short, side-notched, concave-based points (Fig. 1 *l-p, s*); side-notched points with flat or slightly convex bases (Fig. 1 *q, v, z, aa*); a broad, convex-based point with wide stem and deep side-notching (Fig. 1 *w*). One of the illustrated specimens (Fig. 1 *r*) may be a drill; the constricted end, though broken, is thickened. The two drills (Fig. 1 *dd, ee*) are not of much diagnostic value. Likewise, the large cores, which bear only slight indications of use as chopping tools, are found at almost all sites in this area where they are consciously sought.

In summary, surface collecting at the Edgar site has produced a range of material which closely conforms to that from the two levels at the McKean site. As Mulloy (1954b: 453-6) has stressed, this kind of material is closely connected to the two earlier levels in Signal Butte (Strong 1935), with the McKean Lower Level probably equating with Signal Butte I and the Upper Level with Signal Butte II. There are radiocarbon dates of 3287±600 years B.P. for the McKean Upper Level and 3540±220, 3350±250, and 3506±220 years B.P. for comparable material from the Shoshone Basin of Wyoming (Mulloy 1954b: 456). Signal Butte I is dated at 3440±120 and 2950±200 years B.P. (Libby 1954). The Edgar site, therefore, partially fills the long hiatus in northwestern Wyoming between the Cody complex and the historically known tribes in the region. In Mulloy's (1952) system for the Northern Plains this site would fit into the Middle Period, probably the earlier part. Evidence further east suggests that excavation would separate the assemblages at the Edgar site which have been mixed together by erosion and would reveal a stratigraphic succession of them.

LIBBY, W. F.
1954 Chicago Radiocarbon Dates IV. *Science*, Vol. 119, No. 3083, pp. 135-40. Washington.

MULLOY, WILLIAM
1952 The Northern Plains. In *Archeology of Eastern United States*, edited by J. B. Griffin, pp. 124-38. University of Chicago Press.
1954a Archaeological Investigations in the Shoshone Basin. *University of Wyoming Publications*, Vol. 18, No. 1. Laramie.
1954b The McKean Site in Northeastern Wyoming. *Southwestern Journal of Anthropology*, Vol. 10, No. 4, pp. 432-60. Albuquerque.

STRONG, W. D.
1935 An Introduction to Nebraska Archeology. *Smithsonian Miscellaneous Collections*, Vol. 93, No. 10. Washington.

WORMINGTON, H. M.
1957 Ancient Man in North America, fourth edition. *Denver Museum of Natural History, Popular Series*, No. 4. Denver.

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REVIEWS

Edited by Donald Collier

The Identification of Non-Artifactual Archaeological Materials. Edited by Walter W. Taylor. Publication 565, National Academy of Sciences — National Research Council, Washington, 1957. 64 pp.

This may well be an important document; it is a plan for action. I suppose, however, that its importance can be assessed only during the next decade, as it succeeds or fails in guiding that action. The publication reports the results of a symposium held in Chicago March 11-13, 1956, by the Committee on Archaeological Identification, Division of Anthropology and Psychology, National Research Council. It contains short papers by 25 authors in a review of the complexities inherent in the archaeologist's need for expert assistance with identification of the botanical, osteological, mineral, molluscan, and other materials he preserves for study during archaeological work. The papers are by specialists in botany, zoology, geology, metallurgy, and radiocarbon dating who had at various times responded to requests from beleaguered archaeological colleagues and therefore understood not only the problems but some of the reasons why some of the problems existed.

As it turns out, the archaeologist had often asked for the wrong thing. The archaeologist rarely wanted identification. What he wanted was aid in interpreting data; in short, he wanted identification as a step toward the interpretation of the species in the cultural context. Interpretation of significance in context proved also to be the goal of the experts in other fields. So all persons agreed upon the objective. Earlier failure to agree seems only to have been failure to communicate. Once a common goal was understood so that the concept could be developed of the archaeologist actually teaming in the field, as well as in the laboratory, with this or that expert from some other discipline, remarkable unanimity of opinion prevailed at the symposium. It then became possible to seek some practical means for bringing the experts and the data together.

Three basic proposals were explored. First, the possibility of establishing a central laboratory staffed by experts was considered. For financial and other reasons this was deemed impractical. A second, and reasonable, proposal was simply the utilization of existing facilities and persons able and willing to cooperate. This idea was endorsed by the group. A third proposal favored by the conferees was the establishment of regional identification centers. To this end a series of resolutions was submitted to the Division of Anthropology and Psychology of the National Research Council recommending the appointment of a standing committee that would continue study of the problem and encourage the needed interdisciplinary collaboration. Much credit is due to J. Charles Kelley, who organized the symposium, to W. W. Taylor, who edited the papers, and to the National Research Council for sponsorship. A major result of this work, it seems to me, is to highlight the catalytic role that the National Research Council has long played and can continue to play in the development of novel ideas within a discipline or in bridging gaps between disciplines.

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A Guide to Archaeological Field Methods, third revised edition. Edited by Robert F. Heizer. National Press, Palo Alto, 1958. ix+162 pp., 12 figs., 6 unnumbered photographs, 2 maps, 9 record forms, 1 chart. $4.00 paper, $5.00 cloth.

Publication of the third revised edition is good evidence of the usefulness of the California *Guide* (formerly *Manual*). The current version is a reworking of the 1953 edition by Heizer, Albert Elsasser, and James Bennyhoff. Notable additions are an expanded bibliography and a reprint of John H. Rowe's "Archaeology as a Career." Judged solely by the statement that the "main purpose of this work, therefore, is not to advise the student of a particular method as much as it is to serve as a guide to published materials where techniques are illustrated by concrete examples," the book is an unqualified success. But the *Guide* contains a great deal more than the modest statement indicates; it offers a systematic exposition of field techniques found to be useful in California archaeology and for the most part applicable to practically any other area. I am not aware of any other source that presents so much information on the basic techniques of dirt archaeology, and I think that all graduate students should be familiar with it.

Any experienced archaeologist will accumulate a considerable number of supplementary marginal notes having to do mostly with local problems, recent developments, and personal preferences in technical details. My jottings include such items as the importance of querying farmers in survey work, the desirability of working with feet and decimals thereof rather than inches for all field measurements, the superiority of the new white glues (they are, I think, water emulsions of vinyl acetate) for practically any field preservation problem, the promise of the proportional flow counter for the laboratory comparison of specimens, and so on. There are some inconsistencies, presumably the result of the numerous original authors and editions. In view of the extensive bibliography (it can be called superb without exaggeration), it is with a deep sense of pride that I point out an overlooked item, Raymond S. Baby's "Hopewell Cremation Practices" (*Ohio Historical Society, Papers on Archaeology*, No. 1, 1954). In more general terms, I would welcome sharper discussion in the sections on typology and cultural classification.

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Ancient Landscapes: Studies in Field Archaeology. JOHN BRADFORD. G. Bell and Sons, Ltd., London, 1957. xvii + 297 pp., 25 figs., 75 pls. 84 s.

The title of this book unfortunately conceals its real worth. In reality, it deals with ancient landscapes as revealed by aerial photography. The book is intended to serve both the specialist and nonspecialist. The latter may find the part intended for him written in a rather summary fashion, but enough references are given to make the book useful for any reader. Just as it was natural for an Englishman in the person of O. G. S. Crawford (with Keiller) to produce *Wessex from the Air* (1928), so it is for another Englishman, and a follower of Crawford, to produce *Ancient Landscapes*. Bradford's publication is a fitting companion to the earlier work. Indeed, between the publication of these two books, nothing of comparative scope has been written. There have been single works on various projects and areas, and a good number of articles, but these have only served to whet the appetite. Thus, Bradford's book has found a ready demand that is especially keen in England, which appears to be the center for archaeological aerial photography. At least two scholars, the author of the book reviewed here and J. K. St. Joseph, are actively engaged in field research and giving lecture courses on aerial photography and archaeology at Oxford and Cambridge, respectively. A post of Curator in Aerial Photography has been created at Cambridge, lending additional weight to the seriousness of the study.

Bradford's book is based on lectures given at Oxford over a span of ten years and is the result of overseas field work in both military and civilian roles. The aim of the book is to "facilitate the recovery of ancient landscapes comprehensively over large areas." What this reviewer feels to be really unique is that Bradford was able to capture archaeology in time as well as in space. For instance, on the Foggia Plain in southern Italy in a single view he was able to catch a Neolithic kraal, a Roman estate, a medieval construction, and a modern settler's farm, all side by side. Bradford emphasizes that everything observable in the photograph of an ancient landscape has a meaning. He advises us that "the first precept in the interpretation of ancient landscapes must be: — Study the *living* landscape in its smallest particulars and *see how it works*." All elements have meanings linked together to form a complete unit. This approach is already familiar.

The primary emphasis in the study is placed on Mediterranean countries, which offer a new and wide scope for aerial discovery. There are five parts to the book. In the first chapter Bradford discusses the general principles and techniques basic to archaeological interpretation of aerial photographs, giving examples from different kinds of sites; in the second, he discusses the disentanglement of the evidence and its appraisal, following discovery from the air. In his third chapter Bradford makes a topographical study of four cemeteries in southern Etruria, which resulted in the mapping of nearly 2000 tumuli. These sites include Cerveteri, Monte Abetone, Tarquinia, and Colle Pantano. The fourth chapter deals with the type of landscape formed by the Roman method of land partition for settling a farm population. This "centuriation," as the system was called, is indelibly imprinted on the landscape on both sides of the central Mediterranean area. Bradford shows in the final section how town plans laid in classical and medieval times have continued to persist up to the present. He illustrates this by giving examples from southern Europe and lands bordering the Mediterranean. Italy, the scene of much of Bradford's field work, gets the greater part of the attention (Paestum, Cosa, Ostia, Pianna Bella, Verona, and so forth). There is no summary chapter, which is a little surprising. The volume is indexed. The references are given in the footnotes on pages where they occur. This is not so handy for quick checking of the bibliography. The majority of the photographs, all of excellent quality, are published for the first time.

Only two pages of this nearly 300-page book deal with aerial photography in the United States. Nevertheless, it is an invaluable reference work embodying the general principles of aerial photography for archaeologists. It will serve well those who cannot obtain items scattered in various journals. For us in the United States the use of aerial photography in archaeology still appears to be in the order of an afterthought. Yet, as Bradford notes, the potential is here. The nucleus of a collection of aerial views of archaeological sites already exists. We have Dache M. Reeve's collection of 654 catalogued aerial photographs of earthworks, and so forth, mainly in the Ohio area (*American Antiquity*, Vol. 2, No. 2, 1936). This invaluable set, taken from 1933 to the war years, constitutes a treasure of documents on American prehistory, especially since some of the sites undoubtedly have been destroyed. As early as 1930 Army fliers took nearly 700 photographs in the Gila River valley for use in the study of prehistoric canals; Army fliers also took aerial photographs on a large scale operation in Peru, mapping archaeological remains with considerable success during the same era (G. R. Johnson, *Peru from the Air*, American Geographical Society, 1930). More recently, the aerial views obtained by the River Basin Surveys of the Smithsonian Institution in 1952 (F. H. H. Roberts, Jr., 1954, *An. Rep. Smithsonian Inst.* for 1953, App. 5) have illustrated the use to which aerial photographs can be put in a salvage program. The secret of bringing the spark to flame seems to lie in focusing the interest of military aviation on the problems of the archaeologist. This precedent has been established in Britain.

To sum up, even though *Ancient Landscapes* contains little pertaining directly to American archaeology, it is still a worthwhile addition to the working library. The number of useful works in this category is scarce.

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The Neolithic Age in Eastern Siberia. HENRY N. MICHAEL. Transactions of the American Philosophical Society, n.s., Vol. 48, Part 2, Philadelphia, 1958. 108 pp., 100 figs., 7 maps, 2 tables. $2.50.

Eastern Siberia, which encompasses the vast area between the Yenisei River and the Pacific watershed, has long been of interest to Americanists as a probable source area for many cultural developments in the New World. For this reason, Michael has performed a genuine educational service by producing this competent and detailed exposition of Soviet published evidence on the major sites of the Eastern Siberian Neolithic, especially those on the Angara River and near Yakutsk. Unfortunately, the work was completed in 1954, and few sources later than 1950 were used. The bulk of Michael's monograph is based on Okladnikov's *Neolithic and Bronze Ages of the Baikal Area: An Historical-Archaeological Study* (reviewed by Tolstoy, 1953, *American Antiquity*, Vol. 18, No. 3, pp. 283-5). Specialists will need to supplement Michael's work with more recent studies by Russian scholars, especially the following:

BEREGOVAYA, N. A.

1954 Arkheologicheskiye nakhodki na o. Chetyrekhstolbovom (Medvezhi ostrova k severu ot ustya r. Kolymy) [Archeological finds on Chetyrekhstolbovoi Island (in the Medvezhi Islands north of the Kolyma River estuary)]. *Sovetskaya Arkheologiya*, Vol. 20, pp. 288-312. Moscow.

1957 Nakhodki doeskimosskikh poseleniy na Alyaske i v prilegayushchikh oblastyakh, po rabotam 1945–1954 gg. [Finds of pre-Eskimo settlements in Alaska and neighboring areas, from works of 1945–1954]. *Sovetskaya Etnografiya* 1957, No. 2, pp. 15-39. Moscow.

BRYUSOV, A. YA.

1953 Nekotoryye teoreticheskiye osnovy khronologiyi neolita [Certain theoretical bases for the chronology of the Neolithic]. *Sovetskaya Arkheologiya*, Vol. 18, pp. 13-48. Moscow.

CHERNETSOV, V. N. AND OTHERS

1953 Drevnaya Istoriya Nizhnego Priobya [Ancient History of the Lower Ob']. *Materialy i Issledovaniya po Arkheologiyi SSSR*, Vol. 35. Moscow.

CHUBAROVA, R. V.

1957 K istoriyi drevneshego naseleniya Sakhalina [On the history of the oldest population of Sakhalin]. *Sovetskaya Etnografiya* 1957, No. 4, pp. 60-75. Moscow.

DEBETS, G. F.

1951 Antropologicheskiye Issledovaniya v Kamchatskoy Oblasti [Physical Anthropological Investigations in Kamchatka Oblast]. *Trudy Instituta Etnografiyi*, Vol. 17. Moscow.

LEVIN, M. G.

1956 Antropologicheskiy material iz Verkholenskogo mogil'nika [Anthropological material from the Verkholensk Cemetery]. *Trudy Instituta Etnografiyi*, Vol. 33, pp. 299-339. Moscow.

OKLADNIKOV, A. P.

1954 Nekotoryye voprosy izucheniya verkhnogo paleolita S.S.S.R. v svete noveyskikh issledovaniy [Certain problems in the study of the Upper Paleolithic of the USSR in light of the most recent investigations]. *Sovetskaya Arkheologiya*, Vol. 21, pp. 5-29. Moscow.

1955a *Istoriya Yakutskoy A.S.S.R.* [History of the Yakut A.S.S.R.]. Volume I, 2nd edition. Moscow.

1955b Neolit i Bronzoviy Vek Pribaykalya, ch. III. Glazkovskoye Vremya [The Neolithic and Bronze Ages of the Baikal Area: Part 3. The Glazkovo Period]. *Materialy i Issledovaniya po Arkheologiyi SSSR*, Vol. 43. Moscow.

Okladnikov (1955a: 79-87, 100-9) contributes preliminary reports on later Neolithic sites on the Lena, about halfway between Lake Baikal and Yakutsk. The most important finds were made in the chernozem deposits of the second terrace of the Lena, at the mouth of the Malaya Munka River. This site affiliates closely with the second layer at Kullata, especially in the presence of miniature end-gravers and side-gravers and in the absence of the characteristically Baikal stone fishes and compound fish hooks. In contrast to Kullata, hunting, especially for moose, Siberian roebuck, and reindeer, predominated over fishing. Also, light surface dwellings rather than semisubterranean ones were used. Textile impressions upon pots and the teeth of domesticated cattle gave evidence of unexpected cultural complexity at Malaya Munka. Debets (1951: 82-95) supplies measurements on 82 Angara Neolithic and Bronze Age skulls: 15 of early Isakovo-Serovo age; 13, Kitoi; and 51, late Glazkovo-Shivera. The entire population appeared homogeneous; Europeoid admixture, if present, evidently took place in the earlier, even pre-Neolithic, period. The remains appeared to be generally ancestral to modern north Eurasian stocks, especially similar to the Yurak Samoyed and, in the east, to Hrdlička's "pre-Aleut" series. Twenty-two of Levin's (1956) skulls from Verkholensk, near Lake Baikal, were of Serovo age; the other 33, of Glazkovo age. Among the former, Levin (p. 311) noted at least three which were visibly Europeoid. After comparing his materials with roughly contemporary skulls from the Transbaikal and Yakutia, he concluded (p. 318) that Europeoid admixture was present but limited to the first area alone, while the skulls from the latter areas belonged to a distinctive low-faced Mongoloid stock. Such a stock compares more closely with the Lapponoids of the west than with the massive-faced modern population of northeastern Siberia. The other sources listed aid primarily in the interpretation of Michael's data, rather than adding to them directly.

In light of these materials the cultural sequence from early Upper Paleolithic to Bronze Age, which has been developed by Okladnikov and presented by Michael (pp. 33, 94-5), appears firm. However, Okladnikov no longer accepts the notion of autochthonous Paleolithic development in Eastern Siberia; today he holds the early culture represented at Mal'ta, Buret' and Oshurkovo to be of European origin (Okladnikov 1955a: 56; 1954). The affinities of the later massive-chopper culture to Mongolian and Manchurian antecedents (especially Ku-hsiang-tung near Harbin) are also stressed (Okladnikov 1955a: 66-7). For the Neolithic, Okladnikov's dates have been reduced by other scholars, for example, Chernetsov (1953, Table 20), who brings Khin to the fourth millennium, and Glazkovo to the late second millennium, B.C. This accords better with the chronology of pottery in the Russian woodlands

(Bryusov 1953: 45) and with the Glazkovo-Seima correlation now accepted by Okladnikov himself (1955b: 188-9). Yet caution in accepting this revision is essential. The early date of 2000 B.C. for the Middle Jomon culture in Japan (Rubin and Alexander, 1958, *Science*, Vol. 127, No. 3313, p. 1486) is a case in point, since the Japanese sequence is related to that of the Amur Neolithic, with the latter in turn tying in with the Baikal series.

Michael stresses the significance of Arctic Eastern Siberia as an area of origin from which Paleo-Eskimo cultures "have derived an important segment of their material contents" (p. 96). In my opinion, the relevance of the Eastern Siberian materials to the question of Eskimo — more properly, Beringian — cultural origins is still uncertain. For overland contacts perhaps the best evidence is the wide Arctic distribution of burins (pp. 96-7), not only in North America but also in the Asiatic tundra from the Khatanga River eastward. But the question of relative age is crucial. Radiocarbon dates for the Denbigh Flint complex are 1500 to 2700 B.C. (Libby, 1954, *Science*, Vol. 119, No. 3803; p. 140); those for the second layer at Kullata near Yakutsk, where especially similar burins have been found (Collins, 1953, *Mems. of the Soc. for Am. Arch.*, No. 9, p. 57), are unquestionably later. In fact Okladnikov dates at late second to early first millenium B.C. and ascribes to a western origin the entire Asiatic-tundra campsite culture, which he characterizes by "the preparation of prismatic nuclei and knife-like lamellae and many-faceted blades; the presence of the bow and arrow (arrowpoints worked on both sides) and round-bottomed pots with striated or globular ornamentation impressed by a stamp or spatula" (Beregovaya 1957: 35-7). But two of these sites — Lake Elgytkhyn (67°20'N 172° E) and Yakitikive'em (67°50' N 179° E) — lack pottery, and may be older than the rest. In short, the problem is unsettled; if the cultures are in fact related, a westward diffusion from Bering Strait should not be ruled out as a possibility, although the future discovery of ancestral horizons in Arctic Asia is more likely.

At present, substantial evidence of Eurasian Arctic sea-mammal hunting cultures is limited to the Ob' and westward (Chernetsov 1953) and to the Kolyma and eastward (Beregovaya 1954). The latter development is specifically Birnirk-Thule in type and post A.D. 500 in age. Between the Ob' and Kolyma, heavy ice and meager life prevail, but a few localities, such as the Khatanga Gulf, abound in mollusks and sculpins and support ringed and bearded seals, walruses, and some white whale (note S. P. Suslov, 1947, *Fizicheskaya Geografiya SSSR* [Physical Geography of the USSR], p. 179, Moscow). Surface collections on the Faddeyev Islands, northwest of Khatanga Gulf, include archaic implements perhaps related to those of the Komsa culture in Scandinavia (Michael, p. 94). In the New Siberian Islands, a bone knife with slate inserts and an ax of mammoth bone were found a century ago (Beregovaya 1954: 291-2). It is likely that umiak-type rowed boats and detachable, open-socketed, two-pronged harpoons were diffused via this route, as suggested by G. Gjessing (1942, *Yngre Steinalder i Nord Norge* [The Neolithic in North Norway], pp. 452-511, Oslo). The extraordinary identities established by Okladnikov (1955a: 131-3) between the stonework of Lake Uolba in northern Yakutia (Michael, p. 91) and the Scandinavian Neolithic about 1500 B.C. can be understood only by reference to such diffusion. Finally, possible diffusions from the rich Ust' Polui culture of the lower Ob' (Chernetsov 1953) to Eskimo culture, especially the dogsled complex, badly need examination.

Nevertheless, the origins of Beringian culture must, in my opinion, be related fundamentally to southern influences. Apart from Debets' somatological evidence, which I discussed above, several of the specific parallels between the Baikal Neolithic and Paleo-Eskimo culture cited by Collins (1943, *Proc. of the Am. Phil. Soc.*, Vol. 86, pp. 220-35) have not as yet been duplicated in the Eastern Siberian Arctic. I refer to side-bladed spears — a striking resemblance to Figure 2 *g* in Collins (1943) is illustrated by Okladnikov (1955b: 75) — slot armor, and circle-and-dot design. These elements probably traveled not inland but by way of the Okhotsk coast, an area of dense settlement by sea-mammal hunting and fishing Tungus in early historic times (note B. O. Dolgikh, 1955, *Kratkiye Soobshch. Inst. Etno. Ak. Nauk*, 24, pp. 30-50). Above all, Chubarova's (1957) discoveries in southern and central Sakhalin have revealed a culture with profound and explicit likenesses to the entire range of Beringian maritime cultures, especially Dorset. These likenesses embrace pottery, stonework, numerous bone artifacts, and especially, an elaborate complex of whaling harpoons.

In summary *The Neolithic Age in Eastern Siberia* is valuable as an effective collation of primary archaeological data. However, the substantial flow of new Soviet field and theoretical studies since 1950 has displaced some of its culture-historical interpretations. Over-all, considerable progress is being realized toward understanding the origins and history of Eastern Siberian Neolithic cultures and the foundations of Beringian culture. In contrast the Eastern Siberian data still shed little light upon the initial peopling of the Americas.

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Die Amerikanischen Megalithkulturen. Horst Nachtigall. Dietrich Reimer Verlag, Berlin, 1958. 272 pp., 256 figs., 4 maps. DM 32 paper, DM 38 cloth.

The sub-title of this publication states in proper Germanic modesty that this hefty volume is only a preliminary study to an even more extensive investigation of the supposed Megalithic cultures of the New World. The author has done a fair job of organizing his material and there is hardly any spot in this hemisphere that he has not touched upon with competence. Nachtigall tries to convince his readers that in the Americas there is an underlying basic Megalith culture. In doing so he has created something of an "M" complex, comparable in conception but not in validity to Vaillant's "Q" complex for Central America.

Due to his familiarity with the Colombian material, the author begins his survey of the supposed Megalithic cultures with the San Agustín stone monuments. From Colombia he leads us through Panama, Costa Rica, Nicaragua, Honduras, British Honduras, Salvador, Guatemala, Mexico, the West Indies, and to the southeastern and western areas of the United States. He then takes us on a quick trip (fortunately not on a raft) back to Ecuador and then on to Peru, Bolivia, northwest Argentina, and Chile. During this guided tour we are introduced to an immense amount of stone sculptures, "highways," and stone house foundations. To be perfectly truthful, the reviewer fails to see any relationship between them other than the fact that they are all made of stone and were manufactured by hand by different pre-Columbian Indian groups. Nachtigall is on much surer ground when he discusses the subject matter of stone sculptures (pp. 189-212) decorated with such widely recurring elements as the jaguar fangs, the trophy heads, human heads emerging from between the jaws of animals or birds, double-headed animals, the human and beast motif, and serpent monsters. There is no question that such motifs do occur with a reasonable regularity throughout the area outlined by Nachtigall. They are represented, however, not only on stone and occur with great chronological irregularity. The author's idea that the place of origin of the Megalithic culture was Mesoamerica, whence it spread north and south along the coasts and waterways, is an interesting theory but the available chronological data do not support it.

The most valuable parts of Nachtigall's book are the nice compilation and the many illustrations of the different stone monuments from the Americas, along with an exhaustive bibliography consisting of no less than 35 pages listing practically every object of stone from the headwaters of the Missouri to the shores of Patagonia.

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Late Nazca Burials in Chaviña, Peru. S. K. LOTHROP AND JOY MAHLER. Appendices by W. C. Root and William J. Young. Papers of the Peabody Museum, Harvard University, Vol. 50, No. 2, Cambridge, 1957. viii+61 pp., 14 figs., 21 pls., 5 tables. $4.50.

Although Peruvianists have been attempting to systematize the phases of Nazca culture for several decades, this is the first published account of total grave contents. Specimens from a grave complex unearthed in 1943 at Chaviña, near the mouth of the Lomas River, and now in the Peabody Museum are fully described by Lothrop and Mahler. The chambers contained burials presumably made at one time, hence the furnishings provide a neat, if small, apprehension of Late Nazca styles at their southern periphery. Cast copper mountings on spearthrowers down-date this technique on the Peruvian south coast, the time being A.D. 576-696 as determined by the Yale Geochronometric Laboratory. About 20 pots, 30 textiles, and a miscellany of gourd, shell, feather, and wooden objects exemplify contemporary Nazcan craftsmanship. The grave complex consisted of seven symmetrically arranged cists of plastered adobe bricks, roofed with lashed poles and covered with cobbles. Three cists were untouched, two were partly looted, and two were emptied before excavation began. Proof of the concurrence of the burials was a severed mouse. The head was in one cist, the body in another; both parts were under intact pole roofings. The three intact graves contained, respectively: two adults; a headless male with a gourd as replacement and an inurned infant; two male (?) children. The disturbed cists no longer held bodies. The spearthrowers were with the headless male and the two children. A notable lack was foodstuffs; peanuts and coca leaves accompanied only the infant. The contents of each cist are listed as well as some objects of uncertain source.

Pottery specimens are 18 vessels, three figurines, and one "intrusive" vessel; all are illustrated. These are thoroughly discussed and analyzed by Lothrop. His comments on multiple slips are especially valuable. The 16 decorated vessels classify as two bowl and eight jar shapes, one of the latter being the head-bridge-spout type. Of these ten shapes only four correspond to previous shape categories as reviewed by Kroeber in 1956; which Chaviña shapes and which Nazca categories are not specified. The remaining shapes are not incongruent, however, as variations of Late Nazca styles (B and Y; or Strong's Late Nazca-Huaca del Loro phases). The so-called "intrusive" bowl is actually an Early Nazca (A) specimen; apparently its exact location in the graves is not known. Absent are expectable shapes such as head-effigy jars and tall cylindrical jars, an absence possibly due to the considerable looting. The motifs provide an even stronger basis for assigning these burials to Late Nazca times. Of these the "cactus-spine demon" and its affinities are most thoroughly described. Because of the variable interrelations of its several component details, for which Lothrop finds no Nazcan antecedents, he concludes that this design complex developed in some as yet undisclosed locale or in some medium other than pottery painting. The latter possibility seems unlikely inasmuch as the diagnostic spine element itself suggests a brush-stroke origin.

Mahler competently analyzes the 32 recovered textiles, most of which are but fragments. The yarns are Z-spun, S-doubled in the preferred South Coast manner, though there is a higher than normal amount of one-ply yarns used. With the exception of nine shawls and nine headbands or belts, the functions of the textiles cannot be determined. The shawl fabrics are sheer, plain weave in rich monotone colors, some of them seamed together in bold color combinations. Of most interest are several pieces of interlocked warp and weft construction of wool in five colors with strictly geometric motifs. This weave has been used to reproduce the Late Nazca florid pottery motifs in cloth, yet these do not appear in the Chaviña examples. Also, except for a trifling amount of needle-knitting, typical Nazcan embroidery is lacking. The tex-

tiles, like the ceramics, suggest both temporal and marginal deviations from the full bloom of Late Nazca style, as if Tiahuanaco were casting its long shadow before.

The headless body from Chaviña motivates Lothrop's discussion of corpse mutilation. Perhaps the occurrence of jawless half-skulls which he cites for Paracas Cavernas may be linked with the motif of jawless, bloody heads on Late Nazca pottery as a persistent theme: the actuality and the imagery.

In reading this publication it should be kept in mind that Strong's "Paracas, Nazca, and Tiahuanacoid Cultural Relationships in South Coastal Peru" (*Mems. Soc. for Am. Arch.* 13) was not available to the authors when they wrote. Their Chaviña materials seem to fit with Strong's from Chavinia Vasurales and with his radiocarbon date series, although Lothrop expresses some doubts about intra-Nazcan chronology (p. 47). The whole story of Nazca is far from complete. This paper by Lothrop and Mahler greatly strengthens the outlines now known.

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Problems in Pre-Columbian Textile Classification. Ina VanStan. Florida State University Studies, No. 29, Florida State University, Tallahassee, 1958. x + 115 pp., 4 figs., 3 pls., 4 tables.

VanStan has studied the Carter Collection of Peruvian textiles at Florida State University. Although not stated in the text, we hear that there are approximately 150 fabrics. Five of these fabrics are exhaustively analyzed as case histories to illustrate some of the problems typical of the work of a museum curator, the student of textiles, and the general archaeologist. A secondary aim is to put on record previously unpublished material. Each of the five fragments is the vehicle for discussion on a series of topics: provenience, techniques and terminology, function, designs and technology, design objectives. The basis for selection seems to have been the fact that all specimens are nontypical. Descriptions are given of colors, fibers, ply, twist, and count, as well as technique and decorative detail, but these features are not presented with equal weight in each case. For example, virtually every yarn of the first textile is recorded, whereas comparable aspects are not tabulated at all for the fourth piece. A more consistent method of presentation might have been employed. Previously published sources regarding each subject are reviewed with considerable care.

The chapter on provenience deals with an unusual tapestry with loop-pile which portrays a naturalistic mammal form. Since the "realistic" is rarely found in Peruvian weaving, the author summarizes instances of realistic motifs in various archaeological areas and periods. In a similar review of technique she discusses the known occurrences of tapestry and loop-pile in Peru. The second chapter is intended to demonstrate the need for a more useful terminology specifically applicable to Peruvian textiles. This problem, of course, has been the subject of many conferences, including one sponsored in 1956 by the *Centre International d'Etude des Textiles Anciens*, where only one of 277 definitions offered for approval was discussed but no agreement reached. The unfinished tapestry in this chapter consists of a narrow band composed of two solid, one terraced and one diamond-patterned strip, woven "more or less independently." In accordance with Peruvian practice, she states, tapestry was not necessarily constructed horizontally row by row. The progress of the work indicates, too, that a needle was the only means for insertion of some yarns. Thus, she outlines some of the controversies concerning the definitions of "needlework" versus "weaving." Many pieces are known only through fragments and it is difficult to infer their function. Even the pieces preserved in pristine state may be problematical. The colored frontispiece, showing such a specimen, illustrates a tapestry roughly V-shaped with two tabs projecting downward from the centers of the sloping sides. This might have been warped as a unit and is undoubtedly a nonstandard shape. Since it cannot be placed in any known use-category, the author assigns it a "ceremonial function." The chapter on design and technology revolves about the obvious instances of copying from one medium to another, which "may have occurred contemporaneously or at different times." Here a small unit design, typical of needle-knitting, is said to have been copied in a tapestry technique. This apparently demonstrates to the author that craftsmanship rather than creativeness dominated the Peruvian artisan. Least concrete is VanStan's chapter on design objectives. A completely commonplace fabric is remarkable to her only for its "comical" character. This, I feel, is an entirely subjective reaction.

In general comment, I would have liked more information concerning the Carter Collection and the time and circumstances under which it was made. Also, since some "very general identification labels were added [by] the *Museo Nacional de Arqueologia* in Lima," it would be interesting to compare the author's conclusions with these labels. The author's physical description of the five textile specimens might well have been expanded to include more of the available material, especially as her conclusions regarding the subjects examined are largely negative and do not suggest a formula for solving general problems.

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The Erland Nordenskiöld Archaeological Collection from Mizque Valley, Bolivia. Stig Rydén. Etnologiska Studier, No. 22, Etnografiska Museet, Göteborg, 1956. 143 pp., 49 figs., 4 maps, 1 table. 22 Kr.

Stig Rydén publishes here the complete archaeological collection made by Nordenskiöld in 1914-15 in the Mizque Valley, southeast of Cochabamba, in eastern Bolivia. Although some of the collection has been illustrated previously in several works Rydén and the Ethnographic

Museum of Göteborg make a very real contribution by illustrating and describing all the material from nine sites visited by the great Swedish ethnographer. The Mizque Valley, like other parts of eastern Bolivia, has been barely scratched archaeologically. Bennett, Rydén himself, Ibarra Grasso and perhaps a few others have reported on a few sites, but no systematic program of excavation has ever been undertaken. This would be desirable because the area is of considerable theoretical importance, providing what would seem to be one of the most favorable environments on the continent for early agricultural development. It is also an area of interaction between the highlands proper, the forests, and the Chaco. Mizque Valley, in a zone of intermediate altitude, is said by Rydén to have been the most important center of grape cultivation in all western South America during the Colonial period. So far, however, nothing of basic importance to the problems of the origin and development of Central Andean culture has been discovered in this seemingly promising area. With the exception of Rydén's finds at Chullpa Pampa, near Cochabamba, nothing antedating Classic Tiahuanaco has been seriously claimed; as is often the case, nearly everything is to be interpreted as of outside origin or inspiration. This applies to Nordenskiöld's collection. It was made by surface collecting and grave excavation, supplemented by some purchases. Only decorated wares and sherds indicating shape were saved, so Rydén has been limited to stylistic analysis with some quantification of shapes. He presents the latter in his Table I, and illustrates all the sherds.

The pottery falls into two principal groups, Decadent Tiahuanaco and Gray Ware. There is no doubt about the first, and Rydén points out that it is not to be confused with Bennett's Derived Tiahuanaco from Arani, which is much closer to Classic Tiahuanaco than is the Mizque Decadent Tiahuanaco. This style is not identical with that of the Titicaca Basin (many of the elements of the Titicaca region are lacking), but is clearly a regional variant of it. Its presence is equated with an Aymara population, which is thought to have been replaced by Quechua speakers in Inca times. It is unfortunate that Rydén has labeled as "Derived" (and refers to it as "Derived Tiahuanacu") a small category of vessels that seem to him to be stylistically later than, or at the very end of, the local Decadent Tiahuanaco. This gives us two "Derived Tiahuanacos," referring to different sets of materials. The term itself is unfortunate; it is to be hoped that it will not persist in future studies. On the basis of the preliminary account of Nordenskiöld's finds, Bennett equated what he could of the material with his own Arani I and II phases. Rydén feels that this cannot properly be done, in view of the selective nature of Nordenskiöld's collection.

Gray Ware, the other principal pottery of the Mizque region, is considered to be probably older than the Decadent Tiahuanaco, although Rydén says this will have to be proved by excavation. It is found at certain sites which show no Tiahuanaco inspired sherds, but is not limited to them. Rydén regards the Gray Ware as representing "an archaic culture spread along the eastern slopes of the Andes in southern Bolivia and northern Argentina." I should be surprised, however, if it should prove to be much older than Classic Tiahuanaco, since it shows some resemblances to La Candelaria and displays some generalized "eastern" traits that presumably are not of great age.

The appendix, by Elisabeth Stromberg, describes and illustrates five fragments of woolen textiles from a burial cave.

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Chichen Itza and its Cenote of Sacrifice: a Comparative Study of Contemporaneous Maya and Toltec. ALFRED M. TOZZER. Memoirs of the Peabody Museum, Harvard University, Vols. 11, 12, Cambridge, 1957. viii + 316 pp., frontis., 709 figs., 27 tables. $25.00 paper, $35.00 cloth.

In 1930 Tozzer wrote a ten-page article on Maya and Toltec figures at Chichén Itzá; now, over 27 years later, we have from the same author an encyclopedic treatment of the subject. Posthumously published, these two valuable volumes are yet another monument to a great scholar and one of the most influential teachers of his time. A sort of Scarlet Pimpernel of anthropology, Tozzer seemed to try to hide his profound scholarship, wide interests, and truly generous nature under a guise of light-hearted, one might almost say trivial, conversational manners, but it was an exceedingly imperceptive person who was fooled for long by his devices. Tozzer spoke of himself as an archaeologist, but he wrote extensively in ethnology, linguistics, physical anthropology, ethnohistory, and the humanities. He buttonholed his graduate students in the museum halls and chided them for their shortcomings, but no one will ever know how very many he anonymously financed, how many lived in his Cambridge home summers, or how often he invited uneasy young Ph.D. applicants to hockey matches, concerts, the theater, or for weekends to his summer place in New Hampshire. Tozzer surely gave the impression of favoring life's comforts, yet most of his field work in the early days was carried out under the hardest, most dangerous circumstances in the Petén and the Lacandón forest. The work under review, like his *Landa* opus, reveals another side of Tozzer's nature that was far from apparent on the surface: his thoroughgoing scholarship, his intimate familiarity with the literature of his field, past and contemporary, and his passion for exhaustive treatment of any subject he undertook to investigate.

Chichen Itza and its Cenote of Sacrifice presents the period of the famous Yucatecan city's contact with Mexico and other centers in Middle America. Tozzer provides as background a concise outline of Maya culture history and the history of the site as revealed through native literature and archaeology. Chichén I was a Late Classic phase, with closer cultural relationships to the south than were

to obtain later. To it belonged the earlier Maya and Puuc-style buildings like the Monjas, Akabtzib, Temple of the Three Lintels, Casa Colorada, and House of the Deer. Tozzer believes that it ended in Katun 8 Ahau, 10.6.0.0.0, A.D. 928-948. In Chichén II, a Mexican Toltec culture penetrated Yucatán, bringing new art and architecture and a Mexican leader, Quetzalcoatl, whom the Maya called Kukulcán I. Among its buildings were the Castillo, Temple of the Chac Mool, High Priest's Grave, the Temple of the Wall Panels, and the Ball Court group. According to the author, this period ended in 10.16.0.0.0, A.D. 1145. Chichén III saw a second Mexican occupation, with art and architecture distinguishable from the preceding remains. Some of its structures were the Mausolea, the Patio Structure, Temple of the Big Tables, Temple of the Warriors Complex, Court of the Thousand Columns, and additions to earlier structures. Atlantean figures are of Chichén III, and plumbate pottery of both II and III. A second Mexican leader with the Quetzalcoatl title or name (Kukulcán II) is associated with the Three Brothers story and the Itzá arrival in Chichén III, which lasts until the founding of Mayapán in 1263. Chichén IV was inserted in the sequence to allow for a postconstruction period from which Mayapán pottery is absent. It ended with the Itzá withdrawal and the Hunac Ceel episode, which Tozzer assigns to 1451 and links with the relatively late (Chichén IV) Cenote of Sacrifice rituals. Chichén V (1460-1542) was a time of disintegration and abandonment, Spanish conquest, and closed with the founding of Mérida.

There follows a lengthy comparative archaeological study, which considers Chichén Itzá in relation to other sites and areas as to architecture, art, pantheons, astronomical features, "monsters," cults of human sacrifice, the Jaguar-Eagle, the ball court, and various artifacts. Next, Toltec ethnology is reviewed at Chichén and at Tula. Chapters 5 and 6 treat of the Cenote cult and other sacrificial rituals in Middle America. Tozzer devotes a final chapter to ancient Maya trade as revealed in foreign objects recovered from the Cenote. Throughout the text, the author refers constantly to Landa's *Relación*, which was authenticated so fully by the Cenote dredging.

In this, his last contribution, as in his *Social Origins and Social Continuities*, his Maya grammar, and the comparative study of Mayas and Lacondones, Tozzer is essentially a descriptive and historical anthropologist; *Chichen Itza* is not concerned with the nature and processes of culture but is a masterly reconstruction of a past civilization and its history. Reconciling all documentary, epigraphic, ceramic, and architectural sources to a single chronological scheme for northern Yucatán is all but impossible. One must accept some and reject others. Placing the Hunac Ceel incident in a late Katun 8 Ahau, for example, usually accompanies a late correlation (say 11.3.0.0.0), but Tozzer accepts the late date for Hunac Ceel and the 11.16.0.0.0 formula for earlier periods, which of course requires a post-Plumbate pre-Mayapán ceramic phase (Chichén IV) to stretch the sequence out to the required number of years. This has been the constant stumbling block for the 11.16.0.0.0 and earlier correlations, and I do not think that Tozzer's or anyone else's scheme yet explains this complex matter.

The comparative studies cover an immense area and at least a 1600-year time span, are well indexed in Volume II, and are supported by copious notes, tables, and an exhaustive bibliography. One can get a long way in almost any Maya research using this book and the Landa volume alone. The section of illustrations reproduces pictures from many works now difficult and expensive to obtain, and thus should be particularly useful to individuals and institutions with limited libraries.

We can be grateful for a number of circumstances: that Tozzer was able to come so close to completing this work, that so many scholars cooperated in its final stages of preparation, that Margaret W. Harrison's experience and talents were available for editing, and that the Peabody Museum supervised this complex project to so successful a conclusion. It is a fitting memorial to Alfred M. Tozzer, and a great contribution to Maya archaeology.

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Die Hieroglyphen der Maya-Handschriften. GÜNTER ZIMMERMANN. Abhandlungen aus dem Gebiet der Auslandskunde, Band 62–Reihe B (Völkerkunde, Kulturgeschichte und Sprachen, Band 34), Universität Hamburg, Cram, de Gruyter & Co., Hamburg, 1956. x+174 pp., about 2000 figs., 8 pls. DM 28.

In 1953 the Hamburg Museum für Völkerkunde und Vorgeschichte initiated a welcome series of publications on Middle American anthropology with a condensation of Günter Zimmermann's dissertation presented to Hamburg University entitled *Kurze Formen-und Begriffssystematik der Hieroglyphen der Mayahandschriften* (Reviewed by J. E. S. Thompson, 1954, *American Antiquity*, Vol. 20, No. 2, p. 189). This paper in considerably enlarged form was republished in 1956 by Hamburg University. Zimmermann's book is the second and more successful serious attempt made thus far to differentiate and catalogue the elements which make up the hieroglyphic writing found in the three existing Maya pre-Columbian manuscripts; the first was by William Gates (1931, *Maya Society, Pub.* 1, Baltimore). Zimmermann has continued beyond the purely descriptive endeavor of Gates into the interpretive field. He presents some essentially sound suggestions as to the nature of Maya writing — in satisfyingly sane contrast to more ambitious and imaginative interpretations which have been widely publicized in the years since World War II.

Zimmermann's classification is a long step forward. Of the 7550 glyphs in the three codices, he finds 5770 sufficiently preserved for purposes of analysis. These contain what he considers 14,150 separate elements, from which he derives 580 basic forms. These he has divided into two classes: 91 affixes and 489 principal characters

(*Hauptzeichen*). One example each of these postulated elements is presented in four synoptic plates little changed from his brief earlier presentation. The major portion of his new work is a catalogue, under the headings of his 489 principal characters, of all glyphs in the codices. The system of notation to describe the positional relationship of the components of compound glyphs is clear, precise, and easy to use after a bit of practice. The notation 42.1320i/761:19, for example, describes a glyph with affix No. 42 used as a prefix before principal element No. 1320 (inverted) over principal element No. 761, and affix No. 19 used as a suffix. Each of the glyphs is directly identified as to manuscript of origin and page number.

Until we possess some knowledge of the semantic (or at least phonetic) value of the characters, any such classification, as Zimmermann explicitly recognizes, must of necessity be highly subjective. A precise range of variations cannot be obtained from his strictly limited sample. And it is inevitable that some basic forms which now seem distinct will later be connected, whereas variants now grouped together may be separated into independent elements by later evidence.

Although all glyphs containing only a single principal element are catalogued under the number of the element itself (and thus available for comparative study), this is unfortunately not always the case when more than one principal element occurs in a single glyph. For example the *manik-kan-imix* glyph (160/1324–1321 in Zimmermann's notation) is catalogued under both *manik* (160) and *kan* (1324), but is not listed under *imix* (1321). The combination of *kan* and *quincunx* (1324-1343), which Thompson translates as "yellow maize," is listed under both 1324 and 1343. But the combination of *kan* (1324) and the *cimi*-like head (152) is listed only under 1324. Thus if one looks in Zimmermann's catalogue for a complete listing of the combinations, even within individual glyphs, in which principal elements occur, one looks in vain. And the duplicated listings, being incomplete, become superfluous. It is unfortunate that this duplication was not carried through to completion so that each topical heading in the catalogue would not only describe the apparent range of variation but also the range of association with other elements.

The affixes are probably the most challenging aspect of Maya writing, not only because they are the most numerous, but also because they show the most variability in form and in spatial relationship to the more stable and (originally, at least) more ideographic principal elements which they most certainly modify. Their better understanding may define the extent to which the ancient writers had progressed between mechanical semantic modification of verbal or nominal (but *conceptual*) principal forms — and phonetic modifications of what had essentially become phonemic root forms in a more advanced state of writing. Zimmermann has confined himself to a brief synoptic presentation (Plate 1) of 91 affixes, grouped roughly by their use as prefix, superfix, suffix, or postfix, followed by a short listing of some of their occurrences with each other and with the principal forms. Except when used as principal elements, no attempt has been made to illustrate the range of variation of these forms, the validity of which can be assessed only by groping at length for the identifying affix numbers through the long catalogue of elements accompanying the principal forms. This very vital segment of Maya writing would well have deserved descriptive treatment in greater detail.

Zimmermann then carries his classification further by analyzing recurrent appearances of separate glyphs either with pictures of deities or with other glyphs in apparent semantic association. As he notes, these exercises do not aim directly at *translation* of the glyphs but serve to define apparent processes and constructions in the mechanics of Maya writing that could be steps towards later decipherment. Examples of these steps are: *a*, his reclassification of deities and animals in manuscripts, and a reclassification of the clearly associated "name glyphs"; *b*, the subdivision of these representations into what he calls "positive" and "negative aspects" corresponding to their augural function in the divinitory almanacs, and the clear correlation of each of these "aspects" with groups of glyphs of constant formula which he names "attributive glyphs"; and finally, *c*, the definition of a series of glyphs showing a meaningful relation to the well known "offertory" glyphs.

Two essential weaknesses must be mentioned in Zimmermann's presentation. The first of these is the fact that the study itself was limited to the codices — only a fragment of the large corpus of known Maya writing. When the much larger body of data in the inscriptions is added, the identity of some separate forms in the present classification will doubtless merge, whereas what are presently regarded as variants may clarify as distinct forms. More important, a large number of new forms will doubtless appear. The framework of the taxonomy should have been left sufficiently flexible to accommodate these later changes. And in some cases this has not been done. For example, Eric Thompson has been working for some years on a catalogue of all Maya glyphs, which he informs the reviewer will probably reach press sometime in 1959. In his previously mentioned review of Zimmermann's earlier article, Thompson warned that inclusion of material in the inscriptions would greatly increase the number of elements to be catalogued, suggesting in particular that Zimmermann leave more than 100 numbers for the affixes. Although this could easily have been done simply by starting numeration of the principal elements at 400 instead of 100 when the presently reviewed work was prepared, it was not. And Thompson now writes that he has therefore been forced to replace Zimmermann's system of notation rather than use it as a base for his considerably more extensive survey.

The second weakness lies in Zimmermann's failure to include in his synoptic discussions of the various glyphic elements many data published by other students. This includes many cases of almost certain identification of meaning, other suggestions as to phonetic or phonemic value, or merely contextual relationship of the glyphs. If these previous suggestions had been fully catalogued (and

the job would not have been a tremendous one), the present paper's value as a reference work would have been greatly enhanced. For example, a number of the affixes defined by Zimmermann are of almost certain ideographic or phonetic value or both; for example, Nos. 20, 21, 22, which probably represent respectively the colors red, white, and black, are associated with world directions, and probably correspond to phonemic equivalents such as, respectively, *chac, zac, ek,* or again No. 80, which Thompson (1950) has published considerable reason to interpret as the Maya attributive suffix *il*. Similarly, under the listings of principal elements, many highly pertinent published suggestions have been ignored, for example, No. 1307, translated by Thompson as "seed"; No. 160 whose phonetic interpretation has been discussed by Whorf (1933, *Papers of the Peabody Museum*, Vol. 13, No. 2), by the present reviewer (1938, *Am. Anthrop.*, Vol. 40, No. 4, pp. 755-58), and by others; few of the very numerous classificatory and descriptive identifications made by Beyer (1937, *Carnegie Institution of Washington, Pub.* 483, Contrib. 21 and many other publications) have been referred to.

This lack of reference to previous published work, often in the face of very similar conclusion or result, is also characteristic of the interpretive sections of the paper. It is not clear, for example, to what extent Zimmermann has drawn on previous, and often strikingly similar, demonstrations in Thompson's *Maya Hieroglyphic Writing: Introduction,* or has evolved these ideas independently by application of his own methodologies.

Notwithstanding the various strictures mentioned above, this work is a major contribution to the study of Maya writing, and the classification is essentially valid in all of its ramifications. In our present ignorance of the real function of the many elements involved, such a classification must be subjective. But the author should be congratulated on his judgment in handling the material. What he has published is without question the most thorough and satisfactory ordering of the data of the codices yet to appear. And his further interpretive suggestions offer promise to future investigations.

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Tallas Prehispanicas en Madera. Eduardo Noguera. Editorial Guarania, Mexico, 1958. 80 pp., 29 pls.

The principal function of this book, as stated in its foreword, is to provide in Spanish something similar to Saville's *The Wood-Carver's Art in Ancient Mexico.* It is shorter and less complete than that book, but is organized in the same way with accounts of the sources and uses of wood in ancient Mexico, followed by descriptions of a number of the surviving examples of carved wooden idols, spearthrowers, drums, and so forth. Many of the photographs and drawings are identical to those in Saville's work. Several *teponaztlis,* apparently unknown to Saville, are illustrated, as well as some wooden objects found archaeologically in recent years. The latter are a wooden idol from a cave in Guerrero, two *atlatls* from Morelos, and a fragment of a unique wooden smoking pipe found by García Payón in his excavations at Calixtlahuaca. There is also a chapter on the use of wood by the Maya based on historical accounts and with brief descriptions of the carved lintels at Tikal and Chichén Itzá and of other smaller wooden objects, but unillustrated except for a drawing of one of the Chichén Itzá lintels. These are valuable additions to Saville's classic treatment of the subject.

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Archaeological Excavations in the Northern Sierra Madre Occidental, Chihuahua and Sonora, Mexico. Robert H. Lister. University of Colorado Studies, Series in Anthropology, No. 7, Boulder, 1958. vii+121 pp., 21 figs., 33 pls., 13 charts. $3.50.

This is another of the series of excellent and highly welcome reports on the archaeology of western and northern Mexico prepared by Lister and his associates. The present report describes the excavations carried out by Lister and his colleagues and assistants in northwestern Chihuahua and adjacent sections of northeastern Sonora, Mexico, in 1951, 1952, 1953, and 1955. In Cave Valley, Chihuahua, stratigraphic trenches were dug in Swallow Cave, Slab Cave, Rincon Cave, Olla Cave, and Corral Cave. In the Arroyo El Concho in Sonora, test trenches were dug in Dark Cave, while surface collections were made at Step Cave, Arch Cave, Red Paint Cave, and Zigzag Cave. Maps were made of all of these caves, and excavations were also made in Las Ventanas Cave on the Rio Garabato in Chihuahua. Although most of the caves possessed architectural features, excavations were stratigraphic trenches. Lister describes the excavations and the artifacts recovered, and there are supplementary reports by Kate Peck Kent on "Textiles from Slab Cave and Corral Cave" and Paul C. Mangelsdorf on "Archaeological Evidence on the Evolution of Maize in Northwestern Mexico."

The lowest level of cultural development was found in Swallow Cave in Cave Valley and is represented by corn cobs (designated "pre-Chapolote" by Mangelsdorf), acorn shells, and crude stone flake scrapers or knives and stone cores. This level is not identified culturally but underlies other remains that probably date from A.D. 700 to 900. The subsurface deposits in the other caves investigated contain remains of the Mogollon culture of the American Southwest. Lister believes that the stage represented is Mogollon 3, which ended around A.D. 900. The most recent levels in the cave, occurring on or near the surface, were associated with cliff dwellings of one to 30 rooms and one to three stories high. The associated cultural materials were Mogollon, apparently of Period 4 (after A.D. 1000). Trade sherds from the Medanos and

Babicora phases of the Casas Grandes (or Chihuahua) culture were found in this level.

Lister believes that the Mogollon culture moved into the northern Sierra Madre Occidental from the north, or perhaps developed locally from a still undiscovered earlier phase; that it came under Pueblo influence bringing the new architectural features; and that it then moved into the valleys to the east and developed under still stronger Pueblo influence, as well as undescribed Mesoamerican influences, into the Casas Grandes culture. Lister also maintains his earlier belief that the Sierra Madre Occidental will yet prove to be the principal corridor along which Mesoamerican influences moved into the American Southwest.

The discovery that the cave remains in the Sierra Madre Occidental in Chihuahua and Sonora belong to the Mogollon culture is highly important, since earlier views identified these remains as primarily Anasazi (or Puebloan) in origin because of the architecture. It is notable that San Francisco Red ware, an important element of the Mogollon ceramic complex in the Southwest, is absent from the Mexican cave assemblages. Lister's finds suggest that archaeologists working in northwestern Mexico will soon be faced with a major problem in cultural identification, the solution of which will be potentially of great importance to both Southwestern and Mesoamerican studies. Farther south in Lister's postulated corridor, ranging from southern Durango (and northern Zacatecas) throughout Durango and into the upper headwaters of the Rio Conchos in the Sierra Madre Occidental of central Chihuahua, our own group of investigators at Southern Illinois University has identified a simple foothill and mountain dwelling occupance, termed the Loma San Gabriel culture. This is a sort of minimum Mogollon-like culture, which apparently goes back into the early centuries of the Christian era and survives without great modification into quite late times there. This culture lacks many specialized Mogollon ceramic traits, notably the Alma corrugated and textured series, but it is nevertheless Mogollon-like in broad aspect. It looks as if further tracing of its extension northward will reveal it to be continuous with Lister's somewhat reduced Mogollon of the Cave Valley region. If this proves to be the case, then Mogollon will be demonstrably the basic Southwestern ceramic culture and Lister's thesis identifying the Sierra Madre Occidental as the corridor of Mesoamerican intrusions into the Southwest will be verified. Obviously, more work is needed in the critical area of the Sierra Madre in central western Chihuahua, south of Lister's zone of concentration and northward from our own work in Durango and extreme southern Chihuahua. Perhaps the unreported work of Richard Brooks for the University of California in this very area will supply the needed data.

Lister's thesis concerning the development of Casas Grandes culture from the Pueblo-influenced Mogollon culture of the mountains seems to me less probable. The Mesoamerican element in Casas Grandes appears to be very great, and Lister's hypothesis seems much too simple. Fortunately, Charles DiPeso now has under way excavations at Casas Grandes that should resolve this question.

One of the important aspects of Lister's work was the discovery of considerable amounts of agricultural remains, principally maize. Mangelsdorf finds that the earliest maize was a "Pre-Chapalote" variety resembling somewhat the Bat Cave maize. Above this was definite "Early Chapalote," and beginning in Level 2 of Swallow Cave there was increasing Teosinte introgression together with the appearance of a new maize type, called Harinoso de Ocho, which has relationships with types from Colombia, the American Southwest, and the Plains! All these elements combined to produce a type, called Cristalina de Chihuahua, which is related to modern Pueblo types of maize. He feels there is strong evidence for the development in this region of essentially Southwestern maize strains. It is regrettable that Mangelsdorf did not also interpret this maize evolution in terms of the better known Southwestern maize strains, such as the Pima-Papago type, the Eastern complex, and the Mexican complex.

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Late Pleistocene and Recent Changes in Land Forms, Climate, and Archaeology in Central Baja California. Brigham A. Arnold. University of California Publications in Geography, Vol. 10, No. 4, University of California Press, Berkeley and Los Angeles, 1957. Pp. 201-318, 8 figs., 16 pls., 8 maps. $3.00.

This study, concerned with "development of the landscape in prehistoric times," is centered on the Chapala Basin in Baja California, comprising eastern and western sub-basins separated by a slight divide. There aridity has preserved a record of "fluctuations of climate, of sea level, and of lake level in a basin which is now dry, as well as differential crustal movements." The basin, now tilted, retains water in only its western part. Five chapters include: Introduction, The Chapala Basin, Physical Record beyond the Chapala Basin, Archaeological Record, Conclusions. An appendix details Mechanical Analysis of Sands. There is no bibliography. Only a third of the paper is primarily concerned with archaeology. This review concerns that part.

The author distinguishes three archaeological assemblages. Of these, the oldest is the "elongate-biface assemblage." "Elongate bifaces" were made from a core by removing large thick flakes from both sides; supplementary flaking is minor. Evidence of use is not clearly established. At four sites artifacts were embedded in gravel flats; at one they were associated with quarrying operations. The collection includes 45 items: 22 elongate bifaces, six discoidal and irregular bifaces, one "chopper," 13 flakes, one well-made scraper plane, one fragment of biface blade, one fragment of projectile point. Arnold believes this to be the oldest assemblage because of extreme weathering and deep discoloration of artifacts by soil solutions, and location of sites in conformity with a

different topography and strand line. He believes elongate bifaces are not preliminary steps in the manufacture of biface blades of the later scraper plane assemblage because of differences of stone; "form . . . unsuited to the production of blades"; differences in weathering; bulbs of percussion on blades, indicating that primary material was a flake rather than core; absence of elongate bifaces from sites of other assemblages and occurrence of only one fragment of a blade with elongate bifaces.

The second, termed "scraper-plane assemblage," and believed to be later than the elongate-biface assemblage, is the most prominent and is represented by a greater quantity and diversity of well-made forms including scraper planes, biface blades, predominantly lanceolate or ovoid stemless projectile points, numerous flakes, and grinding stones. These are rather small, unshaped slabs of granite, felsite, or porphyry, with one or two naturally flat surfaces on which there is an ill-defined abraded area. On this the handstone, a naturally rounded cobble which does not show flattening, was apparently rolled or rocked. Granite grinding stones frequently show extreme weathering. Fist-sized stones found in these sites show evidence of use with fire and may be remains of hearths or residue from stone-boiling. No charcoal, ash, or evidence of burned ground was found. Artifacts of the scraper-plane assemblage are less extensively weathered than those of the elongate-biface assemblage; some are waterworn and some show sandblasting. In typology, the two assemblages contrast strongly. Sites of the scraper-plane assemblage occur around the southern margin of the lake bed in the eastern basin. "There is no site in this group on which waterworn artifacts were not found [even] on the main sand ridge as much as 25 feet above the present dry lake bed." Some artifacts were found under conditions which suggested that they had been eroded from laminated lake deposits by a later strand which truncated the beds. Arnold places the scraper plane assemblage "prior to at least two of the later stands of lake level, one at 20-25 feet, the other at 10-15 feet above the present dry lake bed. It belongs to a time of relatively low lake level; the succeeding rise in lake level seems attributable only to a marked increase in local precipitation." The scraper-plane assemblage as defined within the basin was not represented outside it, but a small collection from four sites with other features in common includes well-made scraper planes. Elongate or discoidal bifaces, smaller and less well made than those from the basin, were found at three of these sites. The author groups these sites with the scraper-plane assemblage because of their "greater diversity of artifact forms, and sometimes projectile points, grinding stones, and biface blades." None of these sites is situated in accord with present water supply or sea level.

Youngest of the three is the "flake-core-chopper assemblage." Flakes are most numerous. A few crude scraper planes occur. Cores, cobbles, or slabs with bifacial percussion flaking on part of the periphery constitute chopper-like forms. Characteristic are smaller projectile points, some finished by pressure flaking, of various forms largely differing from those of the scraper-plane assemblage; grinding stones, some of which show preparation by pecking; and areas of ash and charcoal among groups of basalt fragments. Such sites occur in the sand hills of the western basin and in an area in the sand hills of the eastern basin apart from that in which the scraper-plane assemblage is found. Eight "flake-core-chopper" sites outside the basin include two on which artifacts show some evidence of weathering, four shellmounds on Pacific and Gulf coasts, and two sites in the interior near modern sources of water. Although disposition of these sites in the Chapala Basin suggests association with an extinct lake later in time than the scraper-plane assemblage and the tilting of the basin, Arnold concedes that they may also date from periods when water was available under modern conditions. He concludes that the assemblage represents a long span of time, and that it is indistinguishable from lithic remains of the latest occupation.

Arnold concludes that three major rises in lake level within the Chapala Basin may be referred to three phases of the Wisconsin glaciation and that human occupation of the basin spans the same period. Absence of record of earlier climatic fluctuations is explained by suggesting that the ancestral Pacific slope stream whose upper reaches form the basin was not blocked by lava flows until the latter part of the Pleistocene.

It is difficult at this time to evaluate properly a study of this sort; much relevant material has recently been published or covered in conferences. An indication of the date of completion of the manuscript would have been helpful. The author has not utilized comparative material, to the detriment of the study in hand. Such material includes M. J. Rogers 1929, *The Stone Art of the San Dieguito Plateau*; 1939, *Early Lithic Industries of the Lower Basin of the Colorado River and Adjacent Desert Areas*; 1945, *Yuman Prehistory*, and others. Arnold's "scraper-plane assemblage" and Rogers' San Dieguito–Playa Complex, the "flake-core-chopper assemblage" and the Pinto–Gypsum complex, now termed Amargosa I-II, exhibit striking parallels. Sayles and Antevs published *The Cochise Culture* in 1941. Cochise, again, presents a sequence analogous to Arnold's. Radiocarbon dates have been available since 1951. Haury's *Stratigraphy and Archaeology of Ventana Cave* was published in 1950. The discussion of the placement of Ventana Cave vis-a-vis other Desert cultures and the San Dieguito and Amargosa horizons in particular is of utmost importance to the study in hand. The Tank site, type site of the Topanga culture, was first excavated in 1947; the publication, by Treganza and Malamud, was issued in June, 1950. Since then, information on this and allied sites has accumulated in quantity at Berkeley and Los Angeles. There has been growing opinion that all belong to one tradition, including comparable material, which may have a wide distribution in time and space. Objects fitting the description of "elongate bifaces" have been collected from gravel surfaces of the Mohave Desert at considerable elevation above evident strand lines. They show evidence of age in deep patination and heavy staining. They have never been adequately described in print although their existence has been known for some time. While the report is significant, its value could have been immeasurably increased by in-

clusion of comparative archaeological matter. Perhaps a range of permissive dates would have become evident.

If the lake which inundated sites of the scraper-plane assemblage is to be correlated with one of the major episodes of Wisconsin glaciation and not with a postglacial rainy spell, it is difficult for this reviewer to understand why artifacts are not more heavily rolled unless they were deeply buried. Arnold's "scraper-plane assemblage" includes grinding stones. As yet there is no substantial evidence of food-grinding implements older than 9000 or 10,000 years (Krieger, 1958, *Am. Anth.*, Vol. 60, p. 975). This in itself makes it essential to adduce proof in order to substantiate identification of the lake with a major episode. Until climatic fluctuations of postglacial time are more fully understood, one must keep in mind the possibility that lakes may accumulate in such desert basins after periods of heavy rain (Rogers, 1939, Pl. I; 1945, *Sw. Jour. of Anth.*, Vol. 1, p. 174).

The field work was done in 1949 and 1950. It should have been possible to include comparisons with material published in studies cited above, since all were available by the termination of field work. Results of field work on allied problems carried on elsewhere during examination of the data from Baja California should have contributed to a better placement of the assemblages. Nonetheless, Arnold has attacked at least one phase of the problem of the Desert cultures. It is regrettable that a greater degree of collaboration and exchange between disciplines could not have been achieved.

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Excavations in the McNary Reservoir Basin near Umatilla, Oregon. DOUGLAS OSBORNE. Appendices by M. T. Newman, Arthur Woodward, W. J. Kroll, B. H. McLeod. River Basin Surveys Papers No. 8, Bureau of American Ethnology, Bulletin 166, Smithsonian Institution, Washington, 1957. ix+258 pp., 6 figs., 40 pls., 19 maps, 33 tables. $1.75.

This comprehensive report presents the findings at two sites excavated by Osborne in the McNary Reservoir during the summer of 1948 as part of the Inter-Agency Archeological Salvage Program. The first part describes the village and settlement pattern, burial practices, artifacts, and other cultural features. The analytic second part is devoted to interpretation and to an extensive study of local and extra-local relationships. Adequate maps, excavation charts, profiles, and photographic plates accompany the report, and its value is further enhanced by several excellent appendices. These include articles by well-known specialists on skeletal material, trade goods, and the composition of copper artifacts.

At site 45-BN-53, situated on a natural levee immediately above the water, the most conspicuous features are 183 house pits scattered along the river bank for nearly ¼ mile. Remaining midden deposits are light. Garbage, unfortunately, was dumped over the bank and most of it appears to have been washed away by the river. Burials, if there were any, may have had the same fate. Site 45-BN-3 consisted of "a probable line of dwelling sites" on the landward side of which was midden deposit. There was a large concentration of burials along the midden margin. Varied and rich data were collected on habitations at site BN-53 and on the burial complex at BN-3. Osborne concludes that the sturdy northern or Shuswap type of pit house with permanent roof structure was not characteristic of the Middle Columbia and suggests its development may have been impeded here by lack of suitable timbers. The dwellings at BN-53 appear to have been mat houses with temporary superstructures and rather shallow, somewhat oblong pits. A short ladder entrance probably existed at one end. This type of habitation, Osborne suggests, was midway between the northern pit house and the Great Basin wikiup. Data from BN-3 indicate that burials were of the plank cist type, as a rule well-furnished with useful and ornamental objects. A similar burial complex with local variations was widespread in the recent Plateau.

The excavations yielded relatively few artifacts. Most of the grave furnishings at BN-3 were contact goods which were also found from top to bottom of the midden deposit, indicating a late and rather short period of occupation for BN-3. Changes in the style of buttons made it possible to date this occupation as having lasted from approximately 1750 to 1800. At BN-53 two glass beads (surface finds?) were the only contact goods encountered. The absence of trade materials and horse bones in the house deposits excavated at BN-53 suggests that the occupation of the site was almost entirely in prehistoric times. Its beginnings may go back well beyond the early 18th century, the date suggested by Osborne. Only a few artifacts of bone and antler were recovered. Coarse hammers, choppers, pecking stones, abraders, flake knives, and net sinkers constitute more than half of the artifact sample.

The treatment of chipped stone artifacts is disappointing. Repeatedly Osborne shows a strange reluctance to use accepted terminology, as, for instance, in the following description of a projectile point in which the same word is used to denote several quite different aspects of the artifact: "The blade is broad, short, and the *sides* slightly and smoothly convex. It is made of a flake, flat on both *sides* and . . . has been retouched on both *sides*" (p. 72, italics mine). Osborne has presented us with yet another typology of projectile points and knives without regard for several others already in existence in the Northwest. Even casual checking reveals serious inconsistencies between Osborne's descriptions of individual types, his outline drawings of types and photographs of points classified as belonging to certain types. Thus, it is disconcerting to have a point type (II *c*) described as having a stem expanding toward the base and the type illustration showing a contracting stem, or another type (II *fa*) illustrated with sloping shoulders and a specimen, said to be of this type, described as "well barbed." Osborne compounds the confusion by including among his "stemmed" points triangular side-notched heads which

other workers in the area have consistently classified as "unstemmed." He fails to explain why he devised a new typology. The different types in his small series of specimens could easily have been fitted into Strong's classification. Though this system is not ideal, its usefulness has been demonstrated in several major and minor reports. A prime objective of a typology is to facilitate comparative studies. This aim is wholly defeated by the proliferation of classificatory systems in a single area. But I do not wish to overstress the shortcomings of a work which is admirable in many other respects.

Osborne lists 55 archaeological traits from the McNary sites and details their ethnographic presence or absence among other Plateau groups. According to this table the culture of the McNary sites aligns more closely with that of the Thompson Indians of British Columbia than with geographically nearer groups, including the Umatilla, who in fully historic times inhabited the study area. This rather startling result creates many problems which call for further investigation. Much of the earlier archaeological information that Osborne was compelled to utilize is very unsatisfactory, since most of the recorded manifestations float in time. Thus, when he refers to inhumation practices in the Straits of Georgia — Lower Fraser area he is speaking of a custom that we now know was abandoned there many centuries ago. Distribution studies which are not based on sound chronology obviously will give distorted results. Quite conscious of the inadequacy of many of his data, Osborne presents his conclusions with commendable reticence and an awareness that results of future work may necessitate drastic revisions of some of his present views. Meanwhile, however, we are indebted to him for the tremendous amount of work he has put into this report, and to the other specialists who assisted him in producing this significant contribution to the archaeology of the Pacific Northwest.

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The Pool and Irving Villages, a Study of Hopewellian Occupation in the Illinois River Valley. JOHN C. MC.GREGOR. University of Illinois Press, Urbana, 1958. xii + 232 pp., 59 figs., 12 tables. $3.50.

This study was carried out as part of a long range archaeological research program by the Department of Sociology and Anthropology of the University of Illinois. The purpose of the research was to establish a sound and detailed Hopewellian chronology. The Pool site was excavated because it appeared typical of middle to late Hopewell and the Irving site because it seemed slightly later. The Introduction and early chapters review previous research in the Illinois River valley, present a history of the current project, and summarize ecology, site locations, and Hopewellian culture in general. A list of recent radiocarbon dates on Hopewellian and related sites is provided with a discussion of their significance, following which the method by which the chronology was developed is outlined. Chapter 4, by Jeremiah F. Epstein, is a discussion of ceramics at the Pool site. Epstein's ceramic analysis develops the Pool chronology and extends local Hopewellian chronology backward in time through comparison of Pool with the Havana site chronology worked out earlier by Mc.Gregor (1952, The Havana Site, *Hopewellian Communities in Illinois*, edited by Thorne Deuel, pp. 43-93). Epstein lists pottery types characteristic of the five horizons developed by combining Havana and Pool sequences. Chapter 5, by William E. Taylor, Jr., a more limited but similar study of Irving site ceramics, correlates the Irving sequence with Havana and Pool, and adds an extra horizon to the late end of the sequence. Later chapters describe house types, artifacts other than pottery, evidence for foods, and burial practices. Chapter 10 summarizes the preceding divisions. In Chapter 11 Mc.Gregor offers a series of hypotheses or speculations concerning Hopewell culture, human relations, geographic orientation of the people, and the nature of Hopewell villages and late Hopewell. Three appendices conclude the text. Appendix B reports on an archaeological survey of the Illinois River valley, and is a statement of some importance in itself.

On the whole this is a good paper. The Pool and Irving study, as a clear account of excavation and careful analysis of two good Illinois River valley sites, advances our knowledge of an important aren. In the kind of intensive study attempted, Mc.Gregor and his associates have been successful. Their basic data were collected under nearly ideal conditions. Few bits of possible evidence seem to have been overlooked in the field work, nor were these neglected in later study. Since archaeological research often falls short of the ideal goal of assiduous preservation and utilization of the most minor bits of evidence, it is hard to quarrel with this effort. Perhaps the danger in such intensive "microanalysis" lies in making much of small variations. A bad tendency emerging in Midwestern archaeology is confusion in pottery type naming through synonymy. I believe this has been the case in naming an Ansell ware in this report. From the illustrations and descriptions, Ansell ware appears to me too nearly like Havana ware to warrant segregation, and Taylor, in Appendix B, admits that the new ware follows the trends of Havana ware. Judging from the illustrations, the Pool Stamped type does not differ significantly from what Griffin (1952, Some Early and Middle Woodland Pottery Types in Illinois, *Hopewellian Communities in Illinois*, p. 110) has called Naples Stamped, dentate variety. These examples are noted less as criticism of Mc.Gregor and his students than as a plea for a serious attempt at standardization before the region's ceramic classifications get completely out of hand.

Some students will not agree completely with the hypotheses advanced in Chapter 11. For example, Mc.Gregor looks upon Hopewell as something carried into Illinois from elsewhere by small groups of people. It is suggested that these small groups had an ability to get on well with local indigenous Woodland peoples. I am not convinced of this. Small alien groups with such ability

to maintain cultural integrity when surrounded by differing peoples do not seem to me ethnologically realistic. I believe such groups more likely to have been rapidly assimilated (if not exterminated outright) by the indigenous population unless the immigrants were technologically superior. The question of origin of these immigrants is also important. Mc.Gregor's own list of radiocarbon dates indicates a Hopewell horizon in Illinois as early as in Ohio. Two of the Illinois dates are earlier than Ohio dates, and Mc.Gregor says that he is attracted by the idea of earlier dates in Illinois. That the assemblage of burial traits, finely-made artifacts, and combinations of ceramic attributes termed Hopewellian was part of a religious movement or "cult" seems probable, as does the suggestion that these items were the property of a privileged class. But it is not apparent to me, at least, that they must necessarily have been the property of either a conquering group or of a small group of peaceful invaders able to impose their cultural will upon indigenous peoples. At the present time we simply do not know enough to speculate intelligently on the details of such cultural events as the advent of Hopewell. Our explanations must remain on a more generalized level. However, thorough and intensive studies such as that carried out here by Mc.Gregor and his colleagues should eventually furnish us with the data on which to base more detailed explanations.

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Indian Villages of the Illinois Country. Historic Tribes. WAYNE C. TEMPLE. Illinois State Museum, Scientific Papers, Vol. 2, Part 2, State of Illinois, Springfield, 1958. 218 pp., 5 illus.

The present publication is the second in a series under the general title, *Indian Villages of the Illinois Country*. The earlier *Part 1, Atlas*, edited by Sara Jones Tucker, appeared in 1942; we learn from the present volume that the *Atlas* is to be supplemented by an additional volume of maps prepared by Temple. Unlike George P. Donehoo's *A History of the Indian Villages and Place Names in Pennsylvania*, Temple's study provides no alphabetical listing of towns, and indeed gives few specific names of Indian communities. However, since such names commonly turn out to be names of localities and not, properly, of communities — a point which more than one research student has failed to realize—the author's insistence upon evidence of actual residence rather than upon mere citation of supposed town names is sound procedure. Temple's arrangement of material is by ethnic groups, beginning with the Iliniwek (the Illinois confederacy) and progressing to non-native groups like the eastern Delawares, who merely passed through on their westward migration, and the northern Menominees, some of whom also appeared here briefly and late. Each of these sketches, which range in length from 46 pages on the Iliniwek to four on the Menominees, identifies the group in question, locates its original home so far as this is possible, traces its movements, with special attention to settlements in Illinois, and follows it to its present home.

Superficially these may appear to be historical accounts, and the reader may be puzzled by the curious muting of historic events and personages. There is no appraisal of the 1752 French-Indian attack on Pickawillani, though the event is mentioned casually (pp. 68, 76). There is no real account of the various frontier wars; nor is there any appraisal of individual Indian leaders (though portraits of four are reproduced as illustrations). Pontiac is even introduced (p. 50) as though he had not already appeared two pages earlier. The study is in fact neither historical nor ethnological, though data from both fields are utilized, but undertakes rather to assemble and organize information useful to students in various fields. It is worth noting that the author's official position is that of Curator of Ethnohistory. This field probably is not so much a distinct discipline as a field of cooperation between ethnologists, historians, and others in more effective study of the American Indian. In the past this field has been conspicuous chiefly for the historian's neglect and for the ethnologist's ineffectual use of historical sources. It is in the light — or the obscurity — of this situation that the present contribution is to be appraised and its very real value emphasized.

Such a study as this cannot be complete and final; it would be surprising if the author had not already collected further data. Pennsylvania's and Maryland's official records, as well as those of New York and Virginia, contain references to the western Indians. The Miami Indians (pp. 57-9) appear as "Inomey" and as "Naked Indians" in some records, and in the 1680's and '90's their warriors raided as far afield as Lake Ontario and the falls of Susquehanna and Potomac. The treaty with the Wea and Piankashaw tribes signed by George Croghan in 1750 might be mentioned. (The chief referred to as Mushequanockque on page 75 appears in this treaty as Mishikinoughwee.) Some of the fugitive Fox Indians (p. 91) settled permanently among the Senecas. One may question the explanation offered (p. 134) for the name Main Pogue; *main poche* does not mean "hand bag," and the name may be a corruption of *main pote*, "clubhand." The chief in question is said to have had a congenitally crippled hand. It might reasonably be argued on the other hand that the study tries at times to cover too much history. Attempts to trace Shawnee wanderings can be frustrating and are perhaps irrelevant. No adequate account of the Delawares could be included, and the one presented (pp. 182-3) is somewhat unsatisfactory. Some of these Indians (but not all) began to settle on the Ohio in 1724; others remained in eastern Pennsylvania and New Jersey until much later. Custaloga may have moved to the Wabash about 1773, but he subsequently lived and died (1776) at present New Castle, Pennsylvania. The four Indian portraits are primarily of historic importance (though fuller data would be desirable), and are less useful and pertinent than a one-page map might have been.

In any event, the merits of the present work warrant

recommendation of subsequent and revised editions — in which, incidentally, more thorough proofreading may correct a scattering of typographic errors, somewhat slack punctuation, and a few lapses of grammar. The clean, legible page of the present printing is to be commended, though one must regret the unfortunate contrast provided by the cover, with its lower-case typography. In contrast with the extensive documentation of the text, the formal bibliography (pp. 200-12) shows signs of hasty compilation. Under "Manuscripts" the Baynton-Wharton-Morgan collection is assigned to the period 1723-1755, although citations in footnotes all fall a decade or two later. "Published Source Materials" lists not only sources but also secondary writings. Nor is the listing complete; of the authorities cited in the 26 notes to Chapter 8, for example, seven seem to be omitted from the bibliography. The omission of Maryland and Pennsylvania published sources has been noted; and better documentation is available than the fictionalized *Travels . . . by J. C. B.* (p. 47).

WILLIAM A. HUNTER
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The Archaeology of Coastal North Carolina. WILLIAM G. HAAG. Louisiana State University, Coastal Studies Series, No. 2, Louisiana State University Press, Baton Rouge, 1958. xi+136 pp., 16 figs., 5 tables. $3.00.

The study of the Outer Banks of Coastal North Carolina is essentially have-not archaeology. These slender spits of sand are continually undergoing drastic changes, and as one long familiar with Ocracoke, at least, I was astonished that Haag was able not only to squeeze as much material out of them as he did but also to arrive at one or two interesting conclusions. The sites mapped and recorded were scattered along Bodie, Hatteras, and Ocracoke islands, on Roanoke Island, on the mainland along the shores of Currituck, Albemarle, and Pamlico sounds, and along the Neuse River. The large number of sites surveyed (50), despite the meagerness of most of them, is a tribute to Haag's tenacity and legwork. Eighteen of them yielded less than 15 potsherds apiece. While this might seem much effort for very little, on reflection one realizes that if the archaeology of this area is to be known at all, one must take what he can get. In any event, unless winds, tides, and storms bring new sites to light, this study is probably the best we can look for in the reasonable future, even counting material from (literally) one-sherd sites and pottery retrieved from shallow water where the midden itself has completely disappeared. The aim of this survey was two-fold; "namely, to depict the prehistory of coastal man and to unearth any evidence of the 'Lost Colony.'" In regard to the former, the efforts met with some success. As for the latter, the Lost Colony remains as lost as ever.

As far as material culture is concerned there is very little to go on except pottery. The ceramic picture is one of great conservatism. Fabric-impressed ware, for example, appears in what seem to be the earliest levels and persists right up to the historic contact. Modes of surface treatment are limited: fabric-impressed, cord-marked, net-impressed, and simple stamped, all four of which are found on sand-tempered, grit-tempered, and clay-grit-tempered sherds. Only the fabric impression and simple stamping are found on a shell-tempered paste which apparently is the latest temper mode. Cord-marked wares seem to have dropped out by the protohistoric period. Incised and punctated sherds are rare and usually executed over fabric-impressed surfaces. These Haag regards as trade sherds. Vessel forms are described as roughly uniform and more or less globular. Rims are simple or slightly out-curving, lips rounded or flattened. Interior tooling is frequent. Interior decoration consisting of simple cord-wrapped stick impressions is found frequently on fabric-impressed ware, and on one occasion the fabric itself was used. No attempt was made to break down these various combinations of surface treatment and temper modes into separate pottery types. Only three of the sites were substantial enough for stratigraphic cuts, and the results of these were vague and inconclusive. The evidence, therefore, was not sufficient to justify the setting up of separate types in this otherwise homogeneous and statistically inadequate sample.

The remaining objects of material culture consist of pipe pieces, fragments of steatite bowls, hammerstones, and projectile points. The points are either triangular (some with a slightly concave base) or triangular and "lightly" corner notched. One or two stemmed points were found. The author felt justified in setting up two sub-areas: (1) the Banks area, typified by shell-tempered pottery (chiefly simple stamped), triangular points, little or no cord-marked pottery and pipes ornamented with fine dentate stamping; (2) the Sounds area, typified by cord-marked and net-impressed pottery, stemmed points, and plain obtuse-angled pipes. This paper also covers the physiography of the region, historic accounts of the area, and an interesting correlation of historical and archaeological records.

One is left with the impression that the area in question is the backwater of an even larger cultural backwater. The inlets and sounds are wide and the tides treacherous. With nothing but dugouts (and no sails) at their disposal, there is little wonder that the Indians skirted this region by a generous margin and that it became the cultural cul-de-sac which Haag pictures. Most of the larger currents in aboriginal affairs flowed west of the Alleghenies and south of the Savannah drainage. When a closer analysis of this area is made, I feel sure that temper modes will play a larger role in temporal placements than Haag has allowed them. Working out these details, however, will be a long and tedious task for some poor fellow whose lot I do not envy.

A. J. WARING, JR.
Savannah, Ga.

NOTES AND NEWS

EDITED BY NATHALIE F. S. WOODBURY

GENERAL

A. V. Kidder has received a Guggenheim Fellowship to write what will be the most delightful book in American archaeology — "a book of rambling reminiscences of persons, places, and Southwestern and Mayan archaeology," as he describes it. The book started with a paper on the history of stratigraphic research in the Southwest instigated by Gordon Willey and supported by a grant from the Wenner-Gren Foundation for Anthropological Research. Kidder writes that he was dictating on a wire recorder and "got out of hand," he was having so much fun reminiscing. Kidder recently received a second honor when the Lucy Wharton Drexel Medal of the University Museum of the University of Pennsylvania was presented to him last November 6 for his long and distinguished career in American archaeology. He was cited especially for his work in the Maya field and for leading a number of expeditions in the Southwest. The ceremony preceded the opening of the exhibit, "The Art of the Ancient Maya." Kidder is the 15th recipient of the medal since its establishment in 1902 and the 4th since 1913.

The Tree-Ring Society has announced a new roster of officers. John C. Mc.Gregor, Department of Anthropology, University of Illinois, is president; Charles W. Ferguson, Department of Watershed Management, University of Arizona, secretary-treasurer. Bryant Bannister, Curator of Archaeological Collections, University of Arizona Laboratory of Tree-Ring Research, is the new editor of the *Tree-Ring Bulletin*, and J. L. Giddings, Director of the Haffenreffer Museum, Brown University, is assistant editor. The society was founded in 1934 and has maintained active research and publication in climatology, forestry, astronomy, and ecology, as well as archaeological dating.

The National Park Service established last October a new section, the Branch of Archeology. Part of the Division of Interpretation, it is headed by John M. Corbett. The increasing activity of the Park Service in archaeological development in Parks and Monuments and in reservoir salvage makes a separate administrative unit logical and welcome.

COMMITTEE FOR THE RECOVERY OF ARCHAEOLOGICAL REMAINS

The Committee for the Recovery of Archaeological Remains has recently (September, 1958) published a booklet entitled *The Inter-Agency Archaeological Salvage Program After Twelve Years*. The history of this cooperative enterprise is concisely presented, along with the "who, why, where, what, and when" of salvage archaeology in the United States. The salvage program began in 1945 as the most expedient answer to a critical emergency. Water-control projects, reservoirs, and highway construction made possible by large appropriations from Congress threatened to destroy large segments of America's archaeological material. In such a situation, scientists were compelled to excavate in specific areas endangered at a given time, leaving "problem-oriented" archaeology for more leisurely pursuers. For this reason many people felt that major contributions to our profession could not be made by salvage work. This, of course, is not true.

The booklet states that during the past 12 years over 310 reservoir areas in 42 states have been surveyed and more than 9000 archaeological sites have been recorded, "providing a record of man's achievements in North America over a period of time ranging from more than 10,000 years ago to less than 100 years ago." Over 300 publications to date, varying in kind and scope, form a permanent and usable record of the river basin sites and surveys. With this foundation of factual material well in hand, salvage archaeologists are able effectively to interpret their sometimes restricted findings and achieve integrated regional views of prehistory that are of the utmost significance to the profession. In the Missouri, for example, Stephenson reports that an important segment of aboriginal life in the Plains has been outlined, and investigations "have provided an increasing understanding of cultural relationships and sequences of occupation along the mainstem and confluent streams of the Missouri." What is true in the Missouri is also true in most of our major river valleys. Areas where previously little or no scientific work had been done are now covered by carefully planned, coordinated programs of excavation, competently staffed and adequately financed.

One of the most significant things about the program is the cooperation between private, state, and federal agencies. This is presented on the second page of the booklet. Working with the seven federal agencies primarily concerned are 54 state and private organizations, including universities, museums, historical and archaeological societies, and private companies. While the benefit of the salvage program to American archaeology is enormous, the worth of this program has traveled beyond the borders of the United States. UNESCO has recommended that salvage archaeology programs be set up in European countries, and that when necessary, archaeologists from countries which have established salvage projects be brought in to aid in setting up the new programs. Using the successful United States program as a guide, many countries are inaugurating steps to record their archaeology and to limit the destructive dangers of urban expansion, dam construction, express highways, canals, factory units, and changes in methods of cultivation. One of the most important facets in the American efforts, in fact that which has made the salvage program operative, has been the close cooperation which the archaeologists have enjoyed with the government construction agencies. Every attempt possible is being made to insure that European archaeologists and governments realize the importance of this liaison, and establish it on a firm basis from the very inception of any Old World salvage programs.

J. O. BREW

ARCTIC

W. E. Taylor, Human History Branch, National Museum of Canada, assisted by Charles A. Martijn, Mrs. Taylor, and ten Eskimo men, excavated in 11 Dorset sites on Sugluk Island, Mansel Island, and near Ivugivik, around the northwest tip of the Ungava Peninsula. Of the six sites tested on Mansel Island, two contained house ruins and artifacts of post-Dorset culture, whereas the other four varied in time from proto-Dorset to late Dorset. A human mandible and femur in approximate association with 19 small ivory animal carvings and other specimens were found at one site in an area otherwise almost devoid of cultural material; these may represent the disturbed grave of a shaman. Three of the four Sugluk Island sites were discovered on Taylor's 1957 survey. In one of these, a Terminal Dorset site, a semisubterranean house, was excavated. Its features are strikingly similar to Knuth's double-ellipse house in northeastern Greenland. The fourth Sugluk Island site contained three stratified components. The uppermost of these was early Dorset and yielded a human mandible and three ribs. This mandible, like the one from Mansel Island, is physically Eskimo. The second component seems to represent a slightly earlier period than the first, and the third component, which occurred in permafrost about 4 feet deep, has so far produced only a few artifacts. The group did not take time to excavate in the many houses found, except in the one instance on Sugluk Island. While awaiting transportation a small, middle-period Dorset site was tested near Ivugivik. In addition to the skeletal material, the party returned home with more than 5000 Dorset artifacts and many reject samples.

Assembled by ELMER HARP, JR.

NORTHWEST

MONTANA. During the spring of 1958, Dee Taylor, of Montana State University, explored the Kootenay River country of northwestern Montana, locating several occupation sites on narrow flatlands below Kootenay Falls west of Libby. This area had been partly covered in 1950 by Joel L. Shiner of the River Basin Surveys, Columbia Project. South of Troy there is a long pass or thoroughfare paralleling the Cabinet Range, through which travel is possible to the Clark Fork River. At the crest of this passageway numerous manmade rock piles were found in the midst of a low, broad talus area. Several of these were tested for remains, but since no artifacts or skeletal material were found these features may represent monuments of some sort. Single rock piles are fairly common in western Montana, but clusters are unusual for this area, although they are known east of the continental divide in the Plains area. Archaeological work at Fort Owen (1854-1876) also continued during the 1958 field season.

WASHINGTON. Robert Greengo, University of Washington, reports completion of the Anthropology Department's Dalles Reservoir project and submittal of the final report to the U. S. National Park Service in June, 1958. The Priest Rapids project will continue for several more years. Work there last summer was again done by a field school, with up to 23 people participating. The project involves two dams and their reservoirs. Field work in the reservoir of the lower dam at Priest Rapids proper is now essentially completed, and a preliminary report should be ready by spring. Most of the work was concentrated at four sites, all of which yielded relatively late prehistoric and protohistoric material. Two of the sites, however, had components some 4 m. deep with complexes in the lower levels differing significantly from those in the upper strata. There is a reasonable prospect of establishing a sequence of some time depth. Greengo plans to devote the major effort during the next three years to the reservoir of the upper or Wanapam dam.

The State College of Washington conducted three archaeological field projects last season. One party, under Richard Daugherty, excavated in the Ice Harbor Reservoir area of the lower Snake River with a contract from the National Park Service. The lowest level of the site produced a previously unknown stone industry consisting of side-notched basalt projectile points and large, crude, percussion-flaked scrapers and choppers. Preliminary estimates place this material in the altithermal period. A second crew, directed by Douglas Osborne, dug a series of rock shelters and open sites in the Sun Lakes area of central Washington. One of the open sites yielded a polyhedral core-lamellar flake industry. This work was supported by the Division of Mines and Geology, Washington State Department of Conservation. The third project, under T. Stell Newman, was the excavation of a village site occupied by the Quileute Indians within the historic period, on the coastal strip of the Olympic National Park. Of particular interest was the large quantity of whale bone in the midden. Support for this project came from the National Park Service and from a National Parks Association grant to Newman.

A development which is bound to have a significant influence on the advancement of archaeological research in the state is the formation of the Washington Archaeological Society, an organization of amateurs dedicated, according to Article II of their constitution, "to the diffusion and preservation of archaeological knowledge and related sciences implemented by its members' active participation in and collaboration with programs of archaeological investigations, research, publication and displays." The official repository of the society will be the Washington State Museum at the University of Washington in Seattle. The constitution also stipulates that the society operate under the supervision of a permanent state director who must be a professional archaeologist. James Garner, Assistant Curator in Anthropology at the Washington State Museum, reports that the three chapters of the society, representing 135 members, are in the process of strengthening their organization by creating a statewide organizational structure which will permit them to coordinate their activities more effectively with professional programs and to provide a greater measure of control over indiscriminate digging.

The Washington Archaeological Society completed its first major excavation at the Hermit site (45-KT-6) in the summer of 1958. Located on the west bank of the Columbia River in Kittitas County, this site appears to have been occupied seasonally. Few fish remains were encountered and no specialized woodworking tools were present. The artifact yield, however, was relatively high, particularly in projectile points. A preliminary report on 45-KT-6 was submitted by the society to the Department of the Interior and the final report is scheduled for completion in 1959. Other work in progress includes excavation at the Dusty site (45-WT-18), Brown's Ranch site, a house pit site, and intensive survey work in Grant County. Excavations have been completed at the Cornet Bay site (45-IS-316). Work at this shell midden had been initiated by Alan Bryan for the State Parks and Recreation Commission.

British Columbia. Katherine Capes, working under the auspices of the National Museum of Canada, excavated two of about 30 dome-shaped mounds in an open grassland area of several acres near Courtenay, Vancouver Island. The mounds are from 1 to 5 feet high and measure from 10 to 50 feet across. The fill of the excavated mounds was composed of pebbles, cobbles, and small boulders set in a dark soil matrix that was derived locally. One of the mounds, oblong in shape, covered a line of closely touching rocks, outlining a rough ellipse about 20 by 50 feet, with a 30-foot tail appended. A small round mound was similarly built, but did not cover a stone outline. Much evidence of fire was found from 6 to 18 inches beneath the floor of both mounds, but a direct relationship to the mounds has not been established. A first sample of this charcoal was assigned a date of 4500 ± 200 years by the University of Saskatchewan Radiocarbon Laboratory. Since charcoal was present also in a nearby test pit, particularly along the ramifications of old tree roots, suggesting that the area may have been swept by fire many centuries ago, the dated sample could be of similar origin. A fragment of a faceted ground slate point was found in the fire stratum beneath the larger of the two mounds, but was not associated with charcoal. Such slate points are common in Fraser delta sites of the first millennium B.C. Few other artifacts occur with the mounds and the true nature of these features is still obscure.

During August, 1958, Michael Kew of the Provincial Museum and student assistant John Sendey continued exploratory investigations at the Pender Island Canal site. Further evidence was discovered suggesting a relationship between the early phase of this site and the Locarno Beach–Whalen I complex, for which Borden has radiocarbon dates of around 500 B.C. More intensive excavations at this site are planned.

No major field work was undertaken by the University of British Columbia in the summer of 1958. Borden was on leave of absence, preparing a monograph on the Fraser delta sequence and its implications. If available radiocarbon dates for Alaska and southern British Columbia are correct, current views on early interrelations between the Northwest Coast and Alaska will need to be revised. Much depends on the relative antiquity of the separate phases in the northern and southern centers, and completion of Borden's study will have to await the results of further radiocarbon measurements. In October, 1958, Borden resumed excavations at Tselax, a recent Coast Salish village near the University of British Columbia campus. Work here continued throughout the winter. Through the cooperation of the Indian Agency and the Charles family of the Musqueam Indian band, the University has been able to lease for archaeological investigations in the next four years the last of the large old Indian houses of Tselax village. Radiocarbon analysis suggests A.D. 1300 for the beginning of the settlement. To date more than 3000 artifacts have been recovered at this site in addition to valuable data on food resources, manufacturing techniques, and house construction.

Assembled by Charles E. Borden

CALIFORNIA

During the fall of 1958 the newly formed University of California Archaeological Survey (Los Angeles) undertook a series of minor salvage operations in southern California. The Channel Islands Research Project was set up to make a systematic study of the prehistory of the offshore islands, and work was begun on three of them. M. B. McKusick, C. N. Warren, E. V. T. Warren, and K. L. Johnson made a site survey and conducted limited excavations on San Clemente, and with the cooperation of the National Park Service site surveys were made on Anacapa and Santa Barbara islands.

The University of California, Santa Barbara College, last summer excavated the historic site of Mikiw, 4SBa78, situated on the Dos Pueblos Ranch near Santa Barbara. The field work, which was financed by a donation from Samuel B. Mosher, was directed by William M. Harrison. Testing disclosed that a portion of the historic site is underlain by a much earlier stratum, probably representing the Santa Barbara "Oak Grove Period." Two badly disturbed extended burials were excavated in this lower stratum. The major portion of the summer's work was in an area which contains Spanish material from top to bottom, including glass trade beads, metal objects, Mexican majolica, and orange-glazed Mexican earthenware. In addition a rather rough, unglazed pottery appeared in the upper levels. Projectile points were primarily small concave-based and stemmed types. Quantities of shell and bone fish hooks and innumerable shell beads of several types were recovered. The most important discovery was an oval, basin-shaped house pit, 21 by 19 feet, which was completely excavated, recorded, and photographed, and then roofed over to preserve it until next season's work. Its point of difference from other previously known architectural features is a broad inner rim about 2 feet wide in the shape of a rectangle with rounded corners, 7 by 9 feet, with its long dimension at right angle to the long axis of the structure. On each corner of the inner rim is a large posthole, three of which seem to have held double posts. The floor appears to have

been covered with some type of mud plaster. In some places as many as four layers are apparent, and a fire pit with a stone deflector is cut into the floor near the probable entrance at the south end of the structure facing the ocean. There is evidence that the outer walls were composed of thatch covered with mud. No exterior postholes were found. Consultation with several archaeologists and historians in California has failed to disclose any familiarity with such a structure, the function of which has not been determined. The excavation was part of a continuing program of investigation into the historic and prehistoric cultures of the Santa Barbara region. The primary objective of the current program is to establish the chronological sequence of occupation sites and to describe in detail several representative cultures for the purpose of studying various aspects of culture change.

Adan E. Treganza of San Francisco State College has completed two projects in cooperation with the National Park Service and the University of California at Berkeley. The first was the excavation of three village sites and two dance houses in Trinity Reservoir area. Also, a survey was made of the historic burial pattern among the Trinity Wintu. The second project was the survey of 36 new archaeological sites in the Whisky Town Reservoir area, and three more sites at Redding in the region of the proposed Wintu Pumping Plant. There were three cooperative projects between the California Division of Beaches and Parks and San Francisco State College: extended excavation at Vallejo's Petaluma Adobe, which doubled the known size of the Adobe; investigation of the William B. Ide Adobe in Red Bluff prior to reconstruction; excavation of two 16th century Indian shellmounds at Drakes Bay.

Volunteer student archaeologists under the direction of William Olsen undertook the excavation of several archaeological sites for the State Indian Museum at Sacramento. In one project additional burials were removed from the Late Horizon, Phase I, cemetery at the Mustang Mound (Yol-13) at the confluence of the Feather and Sacramento rivers. Of particular interest were the three dogs found beneath the legs of one burial. The University of California at Berkeley held an archaeological field class, directed by Alex Krieger, at the Mustang Mound this past summer and recovered some 40 burials from this same cemetery. Olsen also recovered 35 burials from a newly recorded Early Horizon site (Bear Creek, SJo-112) near Stockton which has been severely damaged by land chiseling and leveling. A sufficient sample has been obtained to indicate that this Early Horizon site differs from those previously reported in lacking a characteristic artifact type, the charmstone.

Assembled by FRANCIS A. RIDDELL

PLAINS

16TH PLAINS CONFERENCE. The 16th Plains Conference for Archeology, with Henry Hamilton as chairman, took place on Thanksgiving weekend, November 27-29, 1958, at the Laboratory of Anthropology, University of Nebraska, in Lincoln. There were about 70 registrants. The first afternoon's session, chaired by Harold Huscher, was devoted to more than 20 reports on 1958 excavation projects.

On Friday morning there was a symposium on the archaeology of the Southern Plains, with Robert L. Stephenson as moderator. Papers were presented by the following persons (the areas discussed are shown in parentheses): Marvin F. Kivett (Nebraska and its relationships southward), Carlyle S. Smith (Kansas), James B. Shaeffer (Oklahoma), Stephenson (Texas), Arnold M. Withers (Colorado), and Donald J. Lehmer (general correlations). Discussants were John L. Champe, Roscoe Wilmeth, David A. Baerreis, E. Mott Davis, and Marjorie F. Lambert. This session was mainly concerned with the ceramic complexes of the southern Plains and their relationships with neighboring areas. A clear Northern Plains–Southern Plains distinction on the ceramic level, developing apparently after the Great Drought of A.D. 1250-1300, received considerable attention. The border area between North and South was between the Platte and the Arkansas. On Friday afternoon Preston Holder chaired a session on Plains ethnology. The first part of this session was entitled "Plains Indians in the Modern World," and papers were given by Franklin Fenenga, James H. Howard, Walter Hlady, and Earl Dyer, Jr. The second half of the session was an ethnological symposium on Caddoan peoples. Gene Weltfish led off with a paper on ethnohistorical speculations as to Pawnee origins. Champe reiterated his thesis of the morning session, that a drought-induced split of Plains Caddoan speakers, about A.D. 1300, was the key to subsequent disparate developments north and south. Baerreis pointed out that the Caddoans in the Arkansas–Texas heartland were under strong Mississippian influence, and as one goes farther into the Plains this influence diminishes and the cultures undergo strong modification. In addition to those already mentioned the panel of discussants included Kivett, Smith, Lehmer, Shaeffer, and Davis.

Saturday morning was devoted to a session on the Missouri Basin Chronology Program, chaired by Warren W. Caldwell. This chronology program was described in these columns in the July, 1958, issue, and the papers in this session were progress reports, as follows: Stephenson, The Missouri Basin Chronology Program: Introductory Comments; Harry E. Weakly and Richard P. Wheeler, Dendrochronology in the Central and Northern Plains; Alan H. Coogan, The Physical Basis for Chronology in the Big Bend Reservoir; William N. Irving, Pre-Ceramic Chronology in the Big Bend Reservoir; Arthur N. Jelinek, Uses of the Proportional Radiation Flow Counter in Problems of Relative Chronology; C. Bertrand Schultz, Stratigraphic Problems of the Late Pleistocene and Recent Periods; Charles H. McNutt, Radiocarbon Dating in the Missouri Basin Chronology Program (this paper included the announcement of a number of new dates); and Huscher, Chronologies from Ceramic Analysis in the Missouri Basin. The final session was on Saturday afternoon, with Kivett in the chair. Four papers were given on work in the Western and Northwestern Plains: Joe Ben Wheat,

The Olson-Chubbock Site: An Early Site in Southeastern Colorado; Richard G. Forbis, The Old Woman's Buffalo Jump; Thomas Kehoe, Results to Date of Buffalo Drive Studies; and Glenn Sweem, Preliminary Report on the Kaufmann Cave Site, Wyoming.

Stephenson, Missouri Basin Project, Smithsonian Institution, was elected chairman of the 17th Plains Conference, which is to be held in Lincoln on Thanksgiving weekend, 1959.

MONTANA. An interesting historic sites project was carried out in June, 1958, at the Reno–Benteen area of the Custer Battlefield, under the sponsorship of the National Park Service and the Custer Battlefield Historical and Museum Association. The work was done by Robert T. Bray of Effigy Mounds National Monument with a crew of six men. The purpose of the investigation was to locate and restore the physical features associated with the Reno–Benteen phase of the Battle of the Little Big Horn, June 25-26, 1876. Defensive entrenchments, foxholes, and a defensive barricade, which was known to have been thrown up on the night of June 25, were located. A metal detector was of major aid in locating defense lines by finding large numbers of cartridge cases. The hastily buried remains of four fallen cavalrymen were found — an unexpected discovery because it had been thought that all American soldiers killed in the battle had later given formal burial. These four unknown soldiers were given a military funeral and burial at the National Cemetery at the Custer Battlefield. Bray has prepared an extensive manuscript report of his work, copies of which are on file at the Custer Battlefield, Effigy Mounds, in Iowa and the Region 2 and Washington offices of the National Park Service. A selfguiding visitor trail is slated for construction in this section of the National Monument.

TEXAS. We have a summary statement on work for the past eight years in the Texas Panhandle, an area long neglected in these columns. Jack T. Hughes of the Panhandle–Plains Historical Museum has been continuing the survey work conducted for many years by Floyd V. Studer. Surface reconnaissance has recorded 350 sites, including ruins, camps, tipi rings, rock shelters, flint quarries, workshops, cliff drawings, bison kills, mortar holes, caches, and burials. They represent all known High Plains paleo-American complexes, several Archaic complexes, a number of neo-American complexes, and some undefined Historic complexes. Excavations, conducted mainly for salvage reasons, include four Archaic sites, 14 neo-American sites, and five sites of unknown stage. Three sites were stratified. Hughes has also been advising and helping amateur work at four other sites. Some of this work has been published in Volume 28 of the *Panhandle-Plains Historical Review* (1955) and Volume 26 of the *Bulletin of the Texas Archeological Society* (1955).

Hughes reports that in terms of culture stages his general impressions to date are as follows: paleo-Indian remains of many kinds are found throughout the Panhandle, and are unexpectedly numerous in the rolling prairie to the east of the High Plains. Archaic remains are likewise diverse and widespread, are especially common along the caprock escarpment, and show some southeastward affiliations, although the main ties are northward. Neo-American remains include undefined Woodland complexes in the northern Panhandle; Antelope Creek focus and other undefined foci of the Panhandle aspect also dominant in the northern Panhandle, merging eastward with Henrietta and Custer foci, northward with Upper Republican aspect, and westward with Puebloan culture. Puebloan pottery spans the southern Panhandle, and is surprisingly strong along the caprock escarpment. Historic remains show considerable variety but are less abundant than expected.

Assembled by E. MOTT DAVIS

NORTHEAST

MASSACHUSETTS. Wapanucket 6, an Archaic site at Assawompsett Pond in Middleboro Township, Plymouth County, has been dated by the University of Michigan Memorial–Phoenix Radiocarbon Laboratory at 4250±300 years ago. The specimen (M-764) was taken from Hearth 29, Square 0-13, in a yellow sand zone just outside Lodge Floor 5. This site is being excavated by the Cohannet Chapter, Massachusetts Archaeological Society, under the direction of Maurice Robbins.

PENNSYLVANIA. The Pennsylvania State Museum has begun the excavation of a rock shelter, discovered by Melville Corl and John Miller on the Raystown Branch of the Juniata River in Huntingdon County. John Witthoft, representing the Museum, is collaborating with Corl and Edward Stackhouse. The shelter has a 30-foot overhang, a height of 80 feet, and an occupied area 200 feet long with soil fill 30 feet deep. The central part of the shelter has always been dry and contains vegetal debris and ash beds as well as saltpeter deposits. In this area a 30 inch-thick Susquehannock midden, of the mid-16th century, has yielded a large series of crop plant and other vegetal remains, some wooden tools, large quantities of cordage, a fishnet, three pieces of native fabric, and small amounts of human and dog feces. Witthoft reports the fabric is identical with Adena fabrics from Kentucky. Scattered through the midden are fragments of a cannibalized human. Peripheral parts of the shelter have not always been dry. Although plant materials are sporadic and rare, an Early through Late Woodland sequence is revealed. Unfired Vinette I pottery and crude "fishtail" points occur at a depth of 48 inches. The successive cultural levels are separated by rock falls and represent the following complexes: Middle Woodland, Clempson's Island, Shenk's Ferry and Susquehannock mixed with Shenk's Ferry.

Assembled by ALFRED K. GUTHE

SOUTHEAST

Archaeology in the Southeast continues to be mainly concerned with reservoir area salvage. In Georgia Arthur R. Kelly reports work in the Hartwell Reservoir at the

Cherokee site of Chauga, South Carolina, where Robert S. Neitzel has uncovered a mixed Etowah and Savannah occupation in the mound. In the Oliver Dam Reservoir, being constructed by the Georgia Power Company, the University of Georgia is excavating in a site at the dam and in a rock shelter where a long sequence of occupations culminating in Mississippian has been found. Kelly also reports salvage at a "pure" simple-stamped site and a Swift Creek site on Ft. Benning Military Reservation.

Carl Miller of the Smithsonian Institution excavated a stone mound in Hartwell Reservoir which contained superimposed crematory basins. Nearby superimposed house sites showed a sequence of circular houses with wall trenches, then rectangular houses with singly set posts, and finally a large rectangular structure. Nearby were two small pits with skull burials.

Douglas W. Schwartz of the University of Kentucky dug an Early Lithic site in the Barkley Reservoir on the Cumberland River which yielded many large grooved scrapers and one fluted point. In the same reservoir he tested a shallow Archaic site, a deep Mississippian site, and a shallow Woodland site.

Ellis Crawford of the Behringer Museum at Covington, Kentucky, excavated two crematories, one bundle burial, and six extended burials in an Adena mound in Boone County. The log tombs of the extended burials show new Adena traits including dirt-smothered cremation fires.

The Smithsonian Institution–National Geographic work at Russell Cave, Alabama, continued under Carl Miller. The excavations reached cave floor at depths from 42 to 43 feet below the surface. Hearths with bone and flint were found at depths of 31, 35, and 37 feet.

The 15th Southeastern Archeological Conference at the University of North Carolina, December 5-6, dealt with the transition from Archaic to Woodland in the Southeast.

Assembled by CHARLES H. FAIRBANKS

LOWLAND SOUTH AMERICA

BRAZIL. During August-October, 1958, the Centro de Ensino e Pesquizas Arqueológicas, Universidade do Paraná, sponsored the partial excavation of a *sambaqui* near Alexandra in the state of Paraná. The work was directed by Wesley R. Hurt, assisted by Oldemar Blasi. The *sambaqui* is located on a sand bar that rises about 2 m. above the present-day level of highest tide, in the center of mangrove swamp. It measures 66 m. long, 36 m. wide and 8 m. high. A trench through the deposit revealed it to be composed of alternating layers of carbon and shells, with *Anomalocardia* and *Modiolos* the dominant genera. Eight burials were encountered at different levels, at least seven of them flexed. Two were accompanied by artifacts, one with a completely polished celt and a polished stone pendant and the other, a child, with a shell-bead necklace. Characteristic artifacts from the refuse include a large variety of flaked and semipolished axes, choppers, scrapers, pitted hammerstones, and grinding stones. Bone and shell artifacts, which are rare, include bone projectile points, perforated fish vertebrae beads, and shell pendants. Analysis of the material is still in progress, but preliminary comparisons indicate that the culture represented here is distinct from that at other *sambaquis* on the Paraná coast.

Assembled by BETTY J. MEGGERS

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